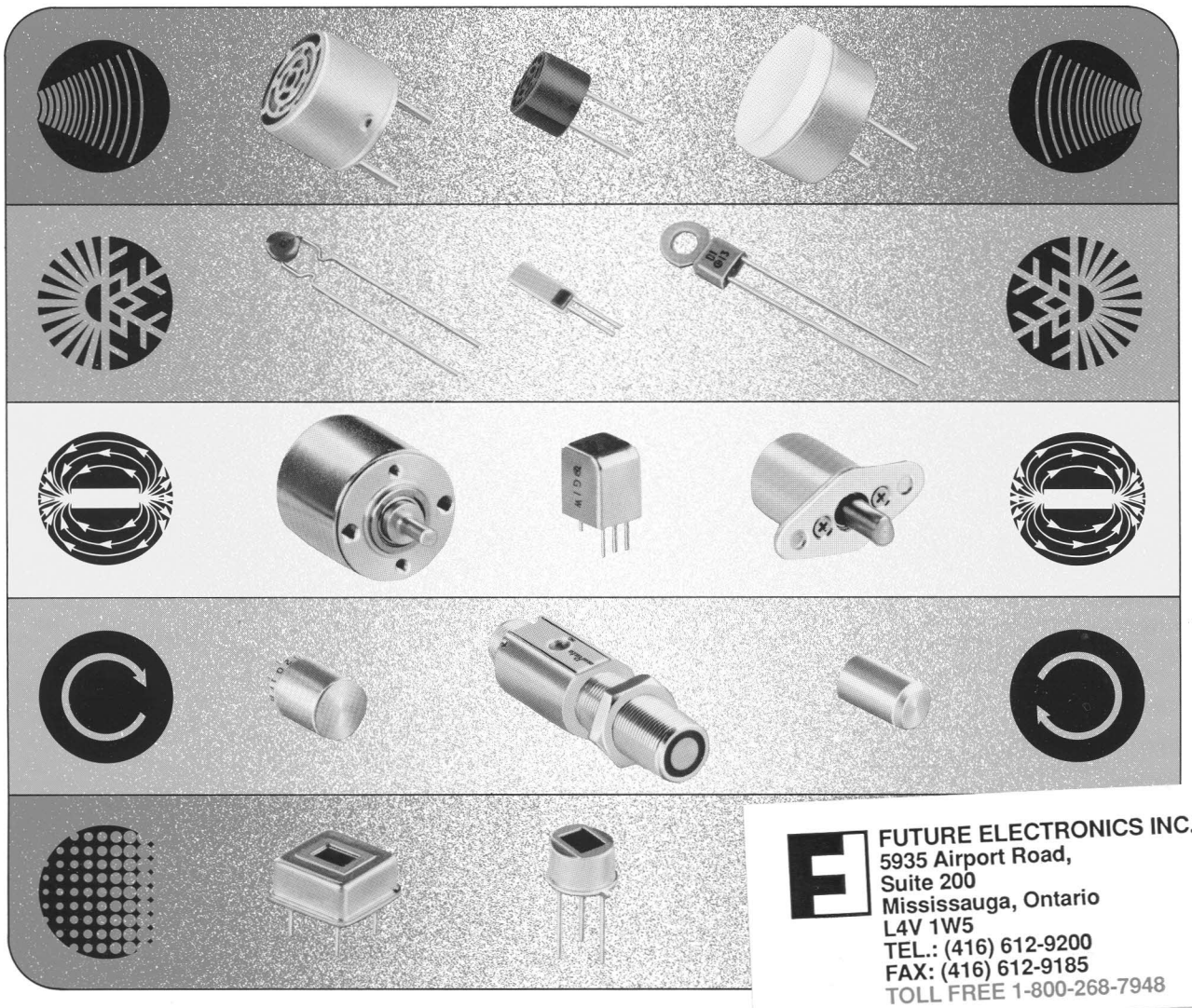
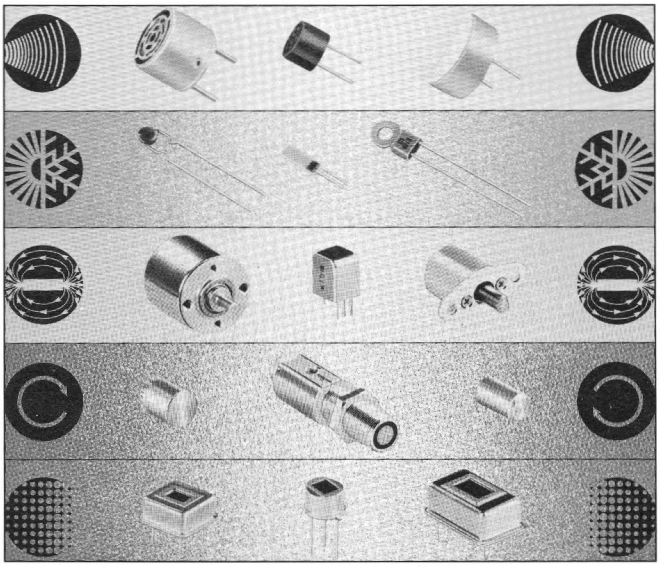
SENSORS

CATALOG NO. S-02-A



muRata ERIE®

MURATA ERIE NORTH AMERICA



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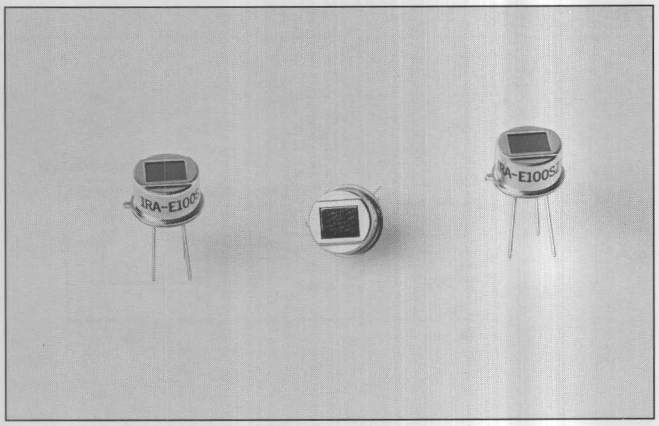
PYROELECTRIC INFRARED SENSORS

murata ERIE

E100/E009 SERIES



Murata Erie's pyroelectric infrared sensors are a result of years of experience in ceramic and HIC® technology. They exhibit both high sensitivity and high reliability. The IRA-E100 Series is offered in various types within the same physical package to greatly simplify selection for specific applications. The IRA-E009SX1 is a quad sensing pattern device suited for top-of-the-line security systems.

FEATURES

IRA-E100 Series

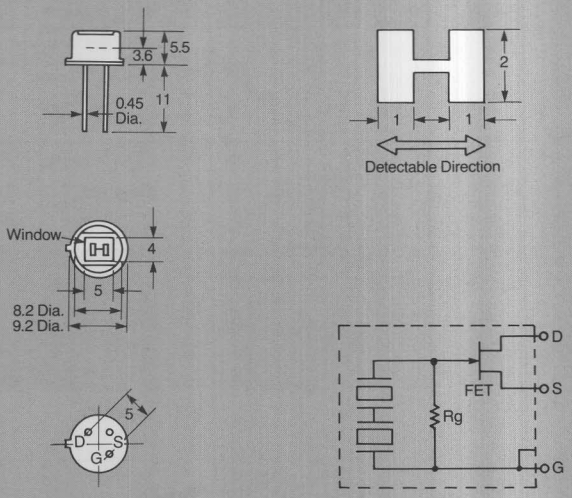
- **All models feature a dual sensing pattern which provides high sensitivity and low noise.**
- **Silicon optical filter prevents RF interference.**
- **Models offered are suitable for a wide range of applications.**
- **Improved optical design provides a wide field of view.**

IRA-E009XS1

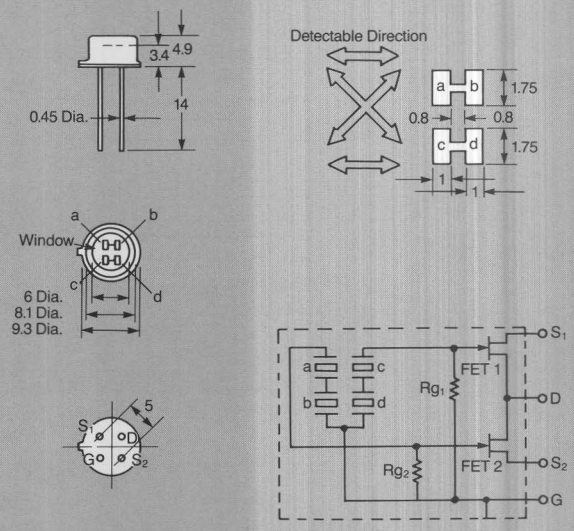
- **Two dual sensing design minimizes problems caused by "Popcorn" noise.**
- **7 μm silicon filter selectively senses human body.**

DIMENSIONS & CIRCUIT DIAGRAMS: mm

IRA-E100 Series



IRA-E009SX1 Series

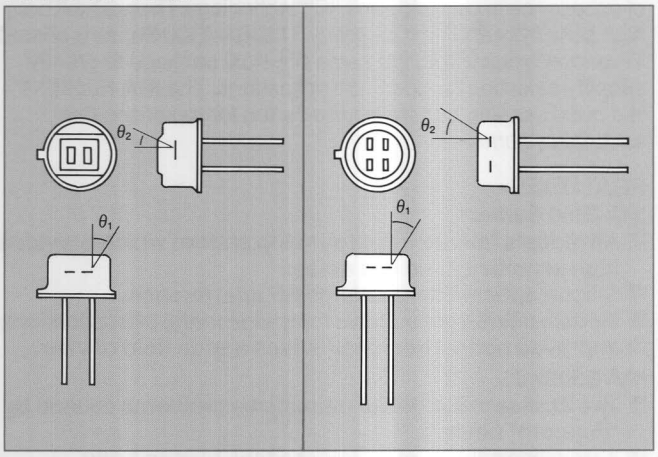


SPECIFICATIONS

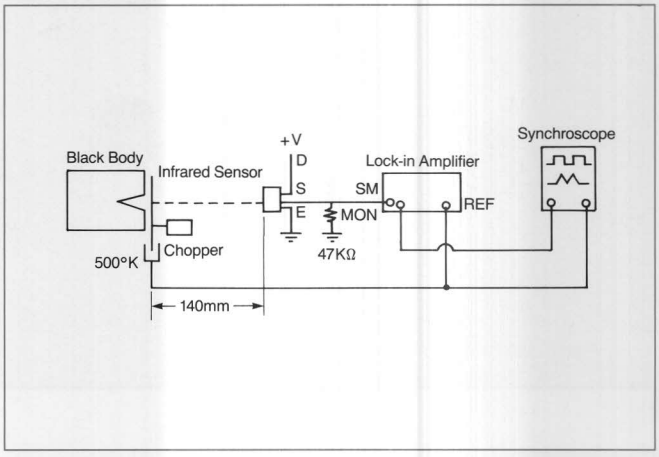
Item	Dual Element				Quad Element
	IRA-E100SZ1	IRA-E100ST1	IRA-E100SV1	IRA-E100S1	IRA-E009SX1
Sensitivity (500°K, 1 Hz, 1 Hz)	1150V/W	1690V/W	1860V/W	1470V/W	1080V/W
Specific Detectivity (500°K, 1 Hz, 1 Hz)	1.2×10^8 cmHz$^{1/2}$/W	1.0×10^8 cmHz$^{1/2}$/W	1.0×10^8 cmHz$^{1/2}$/W	1.0×10^8 cmHz$^{1/2}$/W	0.9×10^8 cmHz$^{1/2}$/W
Wave Length Range*	7 to 14 μm	5 to 14 μm	1 to 20 μm	1 to 20 μm	7 to 14 μm
Rise Time	<25msec				
Field of View	$\theta_1=\theta_2=51°$	$\theta_1=\theta_2=38°$	$\theta_1=\theta_2=38°$	$\theta_1=\theta_2=38°$	$\theta_1=47°$ $\theta_2=32°$
Photoelectric Filter	7 μm long pass silicon	5 μm long pass silicon	silicon AR coat	silicon	7 μm long pass silicon
Electrode	(2×1mm)×2				(1.75×1mm)×4
Supply Voltage	3 to 15V				
Operating Temp. Range	−25 to +55°C				
Storage Temp. Range	−30 to +100°C				

*Determined by window coating.

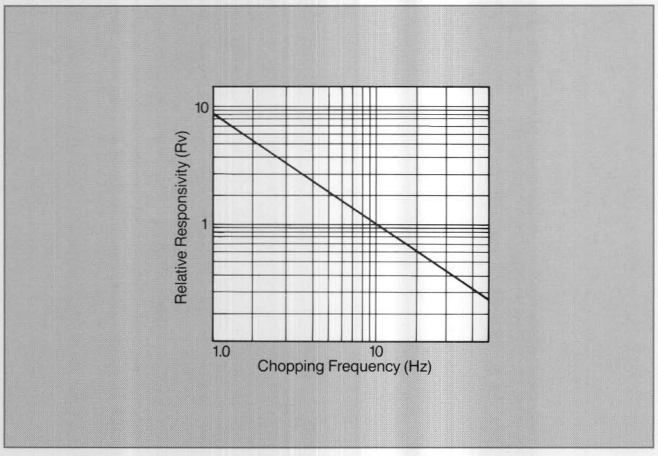
FIELD OF VIEW



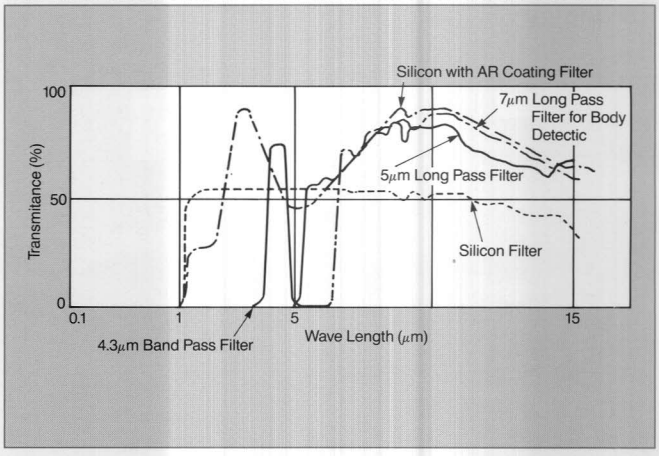
TEST CIRCUIT



FREQUENCY CHARACTERISTICS



SPECTRAL RESPONSE OF WINDOW MATERIALS



RELIABILITY TESTS

Type of Test	Test Conditions*	Results
High Temperature	100°C for 500 hours.	After completion of testing, leave for three hours at room temperature, and then measure. 1. External appearance: No significant damage. 2. Sensitivity: Tolerance within 20% of original value. 3. Noise: Maximum tolerance +100mV of original value.
Low Temperature	−30°C for 500 hours.	
Humidity at High Temperature	60°C (95%RH) for 150 hours.	
Thermal Cycling	20 repetitions of one cycle (−25°C, 30 min. to room temp., 30 min. to +55°C, 30 min.).	
Vibration	Sweep 10Hz to 55Hz to 10Hz for one minute, amplitude of vibration 1.5mm, 60 minutes in horizontal direction and 60 minutes in vertical direction.	
Shock	On standard shock tester at 100G, five times in each of three directions X, Y, Z.	
Soldering Heat	Electrodes dipped until 3mm from the end, soldering temp., 260±5°C for 10±1 seconds.	
Hermetic Sealing	Conforming to Condition D, Chapter 112B, MIL-STD-202F, dipping in fluorocarbon solution (FC-40) at 125±5°C for 20 seconds.	No generation of bubbles.

*All tests with no applied voltage.

PYROELECTRIC INFRARED SENSORS

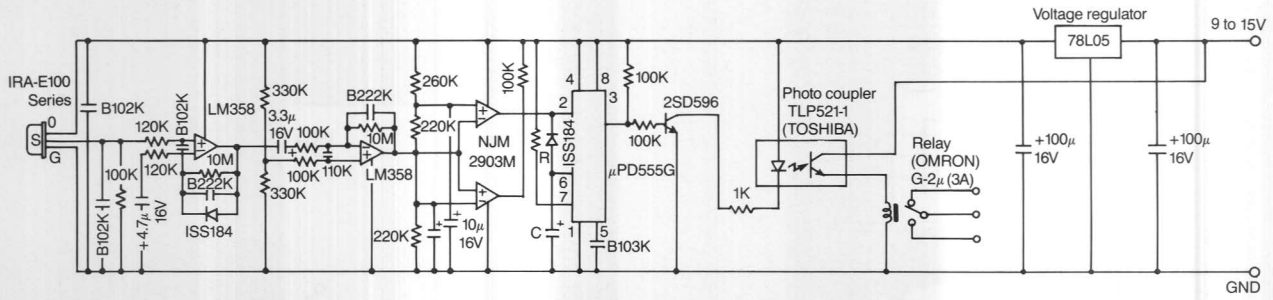
muRata ERIE

E100/E009 SERIES

TYPICAL APPLICATIONS

Part Number	Element	Filter	Major Applications
IRA-E100SZ1	Dual	7 μm	Home security systems Automatic doors
IRA-E100ST1		5 μm	Lighting appliances Household appliances
IRA-E100SV1		1 μm ARcoat	General purpose
IRA-E100S1		1 μm	General purpose
IRA-E009SX1	Quad	7 μm	Office security system

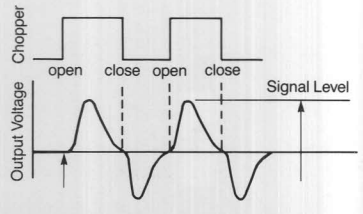
TYPICAL APPLICATION CIRCUIT



APPLICATION NOTES

1. Only a negligible amount of energy emitted from a human body enters the sensor. Consequently, whenever the distance between sensor and object has to be extended for one reason or another, the amount of input energy must be amplified optically by combining with a suitable type of plastic lens or concave mirror.
2. To correctly detect the presence of a human body, an AMP circuit is required for amplification of even the slightest amount of the incidental energy to 60 through 80 dB of signal level, with fo=1 Hz of frequency existing in the center.
3. Never use these sensors in locations where the ambient temperature varies significantly; likewise, in locations where strong vibrations are present.
4. Preferably, these sensors should not be used outdoors.

TYPICAL OUTPUT WAVE SHAPE

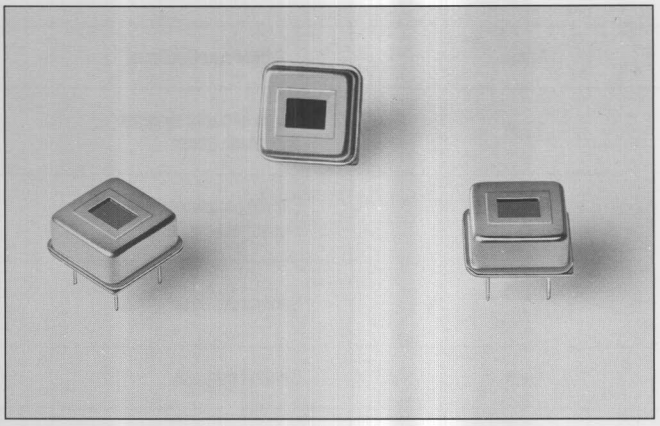


OTHER INFRARED SENSORS

1. The following single-element sensors are available for application in radiation thermometers and flame detecting apparatus:
   - Type IRA-401S1 with a 1 μm long pass filter, for radiation thermometers.
   - Type IRA-401SX1 with a 7 μm long pass filter, for human-body detectors.
   - Type IRA-401QW1 with a 4.3 μm long pass filter, for flame detectors.
2. Infrared sensors for special applications other than the above are available upon request.

PYROELECTRIC CURRENT-MODE INFRARED SENSORS

IRB-MOO2SX



The Murata Erie current-mode pyroelectric infrared sensor features a rapid response as a result of a built-in amplifier circuit. In this current-mode infrared sensor, the charge on the pyroelectric element is fed into the built-in amplifier directly and the output signal is amplified. The response characteristics of this current-mode unit is stable over a wide range of chopping frequencies therefore allowing the detection of extremely fast moving targets.

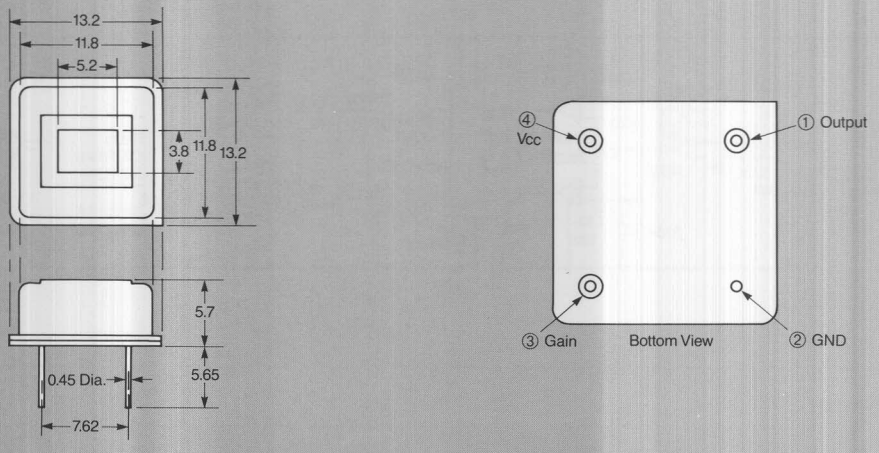
FEATURES

- **Short response time, flat chopping frequency characteristics.**
- **Built-in amplifier circuit.**
- **Excellent sensitivity.**
- **Excellent reliability and EMI characteristics.**
- **Low power consumption.**

APPLICATIONS

- **Human body detection systems, including direction and speed detection.**
- **Detection of small, fast-moving animals.**

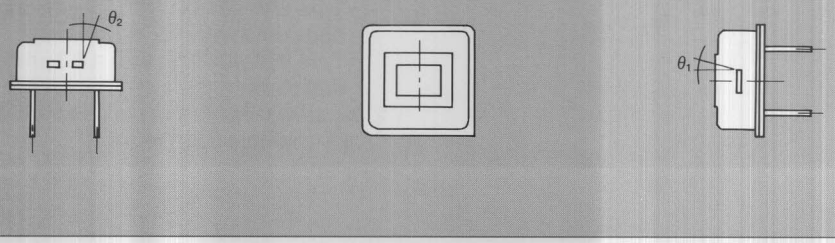
DIMENSIONS: mm



SPECIFICATIONS

Supply Voltage (Vcc)	5.0±0.1VDC
Infrared Responsivity	1.7×10^{10}V/W
Wavelength Range	7 to 14 μm
Field of View	θ_1=41°, θ_2=35°
Operating Temperature (Without condensation)	−25 to +55°C
Storage Temperature	−30 to +100°C
Current Consumption	20 μA

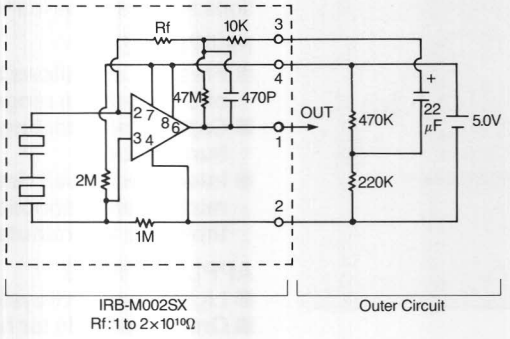
FIELD OF VIEW



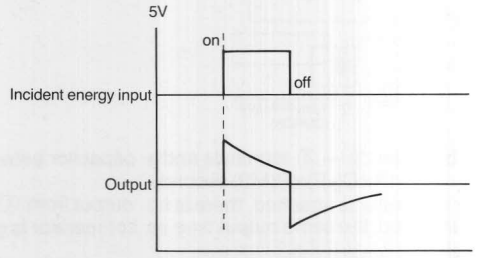
PYROELECTRIC CURRENT-MODE INFRARED SENSOR

IRB-MOO2SX

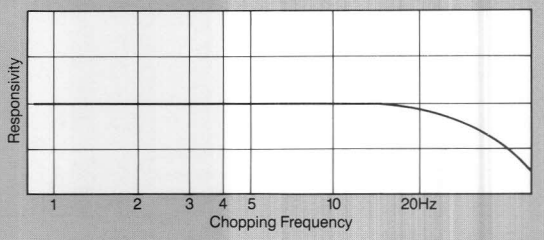
TYPICAL OPERATING CIRCUIT



INPUT/OUTPUT WAVEFORM



FREQUENCY CHARACTERISTICS



APPLICATION NOTES

1. The infrared sensor's impedance is so high that it may be affected by interference such as from electrostatic electricity and EMI. When installing the sensor, shielding is recommended.

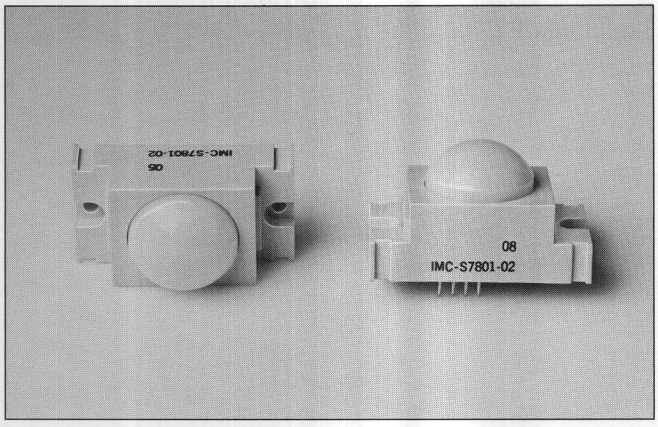
2. The sensor detects the difference between the radiant heat energy of the human body and the background. If the background temperature changes, the detection distance changes as well. It should also be noted that the sensor cannot detect a stationary human body.

3. The power supply should be well regulated.

4. The sensor is not recommended for use under the following conditions:
   a. Outdoors.
   b. Direct exposure to sunlight, car headlights, etc.
   c. Direct exposure to air flow from heaters and air conditioners.
   d. Extreme temperature changes.
   e. Extreme vibration.
   f . Under glass covers.

PYROELECTRIC INFRARED SENSOR MODULE FRESNEL LENS TYPE

IMC-S7801-02



Murata Erie's IMC infrared sensor module utilizes a Fresnel Lens which has 18 detecting zones capable of detecting slight movements, such as that of a human hand, up to 5 meters away. The IMC module is suitable for many different switch applications such as those found in home appliances.

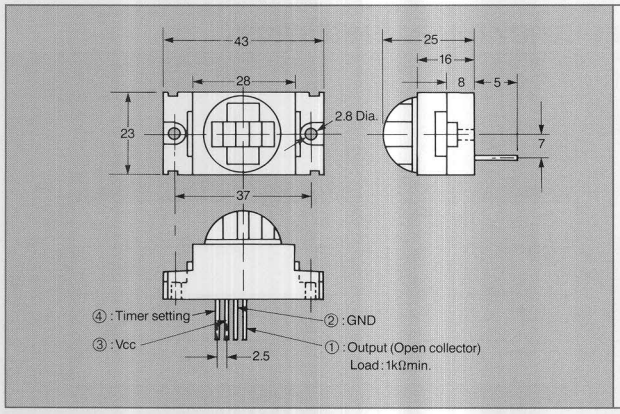
FEATURES

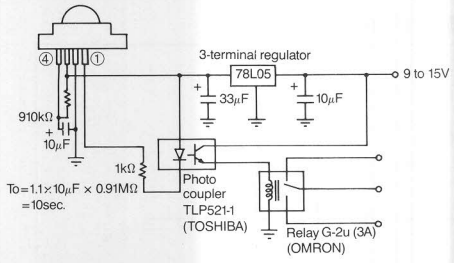
- **Fresnel Lens allows human body detection at a distance of 5 meters at a range of 90°×52.5°**
- **Capable of detecting even the slightest motion of the human body.**
- **Integrated circuit design with open collector output, retriggerable monostable operation and adjustable output timing up to 7 minutes.**

APPLICATIONS

- **Lighting control systems.**
- **On/Off controls for home appliances, industrial and office equipment.**
- **Automatic door switches.**
- **Burglar alarm systems.**
- **Consumer games, toys, etc.**

DIMENSIONS & TYPICAL APPLICATION CIRCUIT: mm



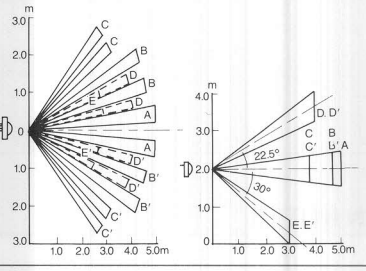


Connect a resistor between ③ — ④ terminals and a capacitor between ② — ④ terminals. To=1.1×C(μF)×R(MΩ) seconds
When no capacitor or resistor is attached, there is no output from ①.
If only a resistor is attached, the same output time as comparator is given from ①.

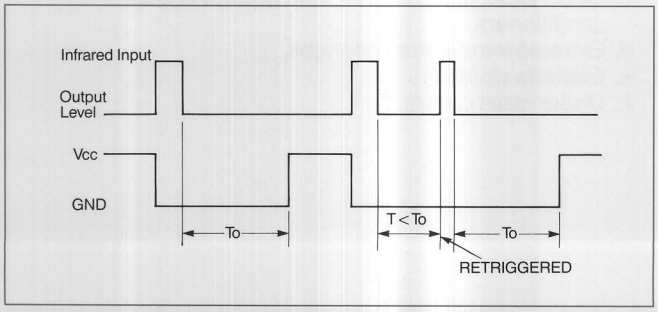
SPECIFICATIONS

Supply Voltage (Vcc)	3 to 5VDC
Supply Current	2.5mA max. when timer is off
Output	Open collector (load ≧ 1kΩ)
Timer	Retriggerable monostable timer One shot time : To=1.1×C(μF)×R(MΩ) [sec]
Infrared Wavelength Range	7 μm to 14 μm
Detection Distance	Typical 5m
Detection Range	90°×52.5° 18-zone
Warm Up Time	Max. 60 seconds
Operating Temperature Range	−20 to +55°C (Without condensation)
Storage Temperature Range	−30 to +80°C
Installation	Indoors

DETECTING AREA



WAVEFORM

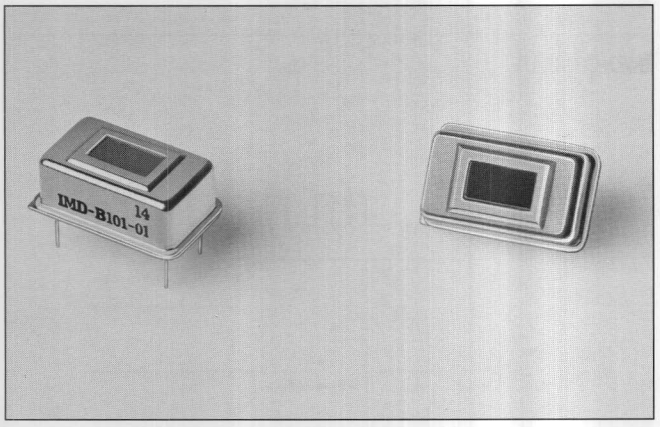


NOTES

1. Because of high impedance of infrared sensor, the module is subject to electrostatic electricity and EMI interference. Metallic shielding is recommended for installation.
2. The module detects the energy difference between the infrared energy emitted by the human body and that from the background, such as walls, etc. Therefore, sensing distance varies with the temperature of background surface. The module won't detect a motionless human being.
3. Power supply should be well regulated.
4. For stable operation following conditions need to be avoided:
   a. Outdoor.
   b. Direct sunlight or headlights of vehicles.
   c. Direct air flow from heater or air conditioner.
   d. Rapidly changing ambient temperature and strong vibration.
   e. Glass cover.

PYROELECTRIC INFRARED SENSOR MODULE

IMD-B101-01/IMD-B102-01



The Murata Erie IMD infrared sensor module combines the company's extensive experience in IR and IC technology to achieve extremely low power dissipation in a small package. The IMD series is available in a hermetically sealed metal can package for numerous digital and analog applications.

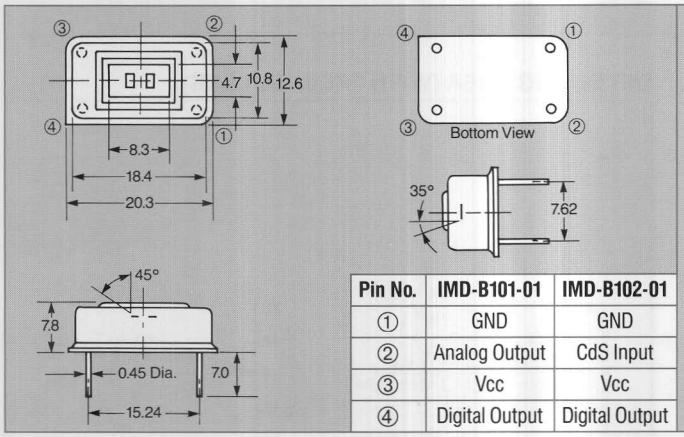
FEATURES

- **Compact size.**
- **Integral amplifier and signal processing circuit.**
- **Outstanding EMI and reliability characteristics.**
- **Low power consumption.**
- **With optional Fresnel Lens, the detection of the human body is at a distance of 3.5 meters over an angle of 104°×30°**

APPLICATIONS

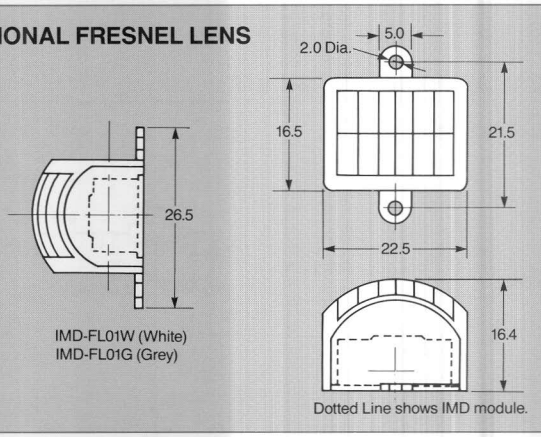
- **Automatic light switch.**
- **On/Off control for home appliances, industrial and office equipment.**
- **Consumer games, toys, etc.**

DIMENSIONS: mm



Pin No.	IMD-B101-01	IMD-B102-01
①	GND	GND
②	Analog Output	CdS Input
③	Vcc	Vcc
④	Digital Output	Digital Output

OPTIONAL FRESNEL LENS



SPECIFICATIONS

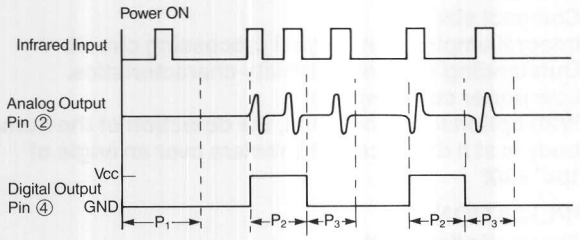
Item			Min.	Typ.	Max.	Unit
Supply Voltage			2.6	—	5.5	V
Current Consumption	Digital Output	Low	30	50	60	μA
		High	50	80	120	μA
Output Current			—	1	—	mA
Stabilizing Time After Power On (P_1)			15	25	40	sec
Output Time (P_2)			1.0	1.9	3.0	sec
Prohibited Time (P_3)			—	2.1	3.0	sec
Input for Pin ②			—	—	Vcc	V
Response Wavelength Range			5	—	14	μm
Detecting Distance (Human Body)	Without Lens		—	1.0	1.5	m
	With Lens		—	3.5	—	m
Operating Temperature (Without Condensation)			−10 to +50			°C
Storage Temperature			−20 to +60			°C

PYROELECTRIC INFRARED SENSOR MODULE

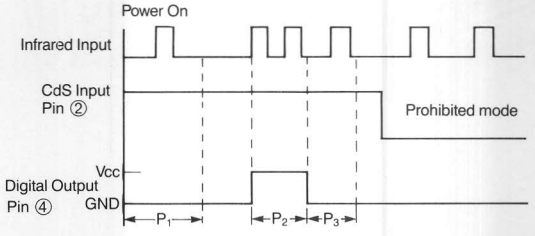
IMD-B101-01/IMD-B102-01

TIMING CHART

IMD-B101-01

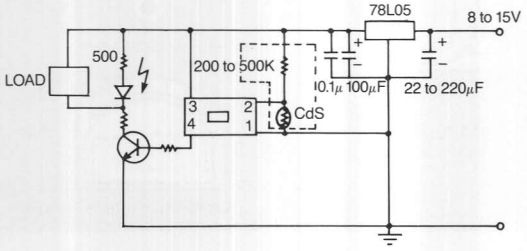


IMD-B102-01



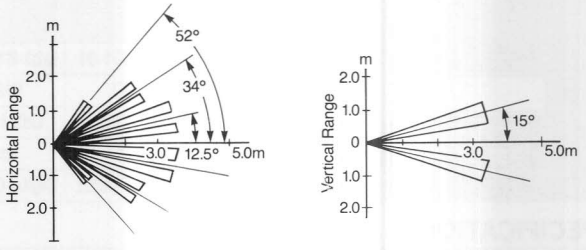
TYPICAL APPLICATION CIRCUIT

IMD-B102-01



CdS Input is required to be Vcc-1.5V or higher to operate.
Note 1: IMD-B101-01 generates analog output at Pin ②.

DETECTING AREA (WITH FRESNEL LENS)



APPLICATION NOTES

1. The sensor module detects the difference of heat energy between the background and the human body. The detectable distance is dependent upon the background temperature. A motionless human body cannot be detected.

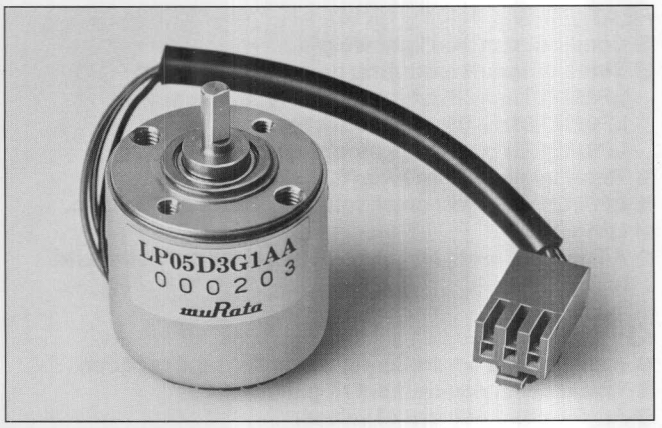
2. A stabilized power supply is required.

3. The module should not be installed in any of the following locations:
   a. Outdoors.
   b. Locations exposed either to sunlight or to motor vehicle headlights which are aimed directly at the sensor.
   c. Locations exposed to direct air flow from a heater or air conditioner.
   d. Locations which are subject to rapid temperature changes.
   e. Locations which are subject to severe vibration.
   f. Locations close to glass or other objects which might reflect the infrared energy.

MAGNETIC ANGLE SENSOR

muRata ERIE

LP05D3G1AA



FEATURES

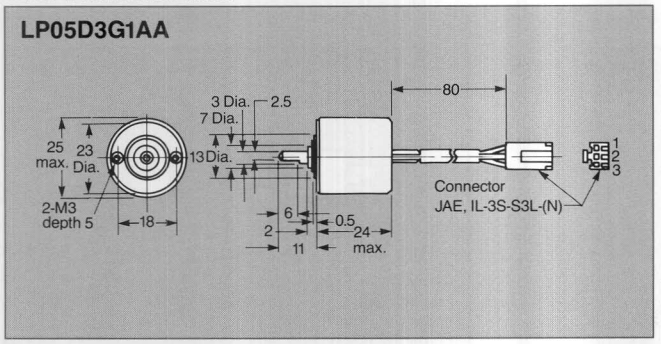
- **Built-in temperature compensation circuit reduces output voltage drift.**
- **Temperature coefficient ratio is as low as ±0.12%/°C within the range of 0°C to +50°C.**

APPLICATIONS

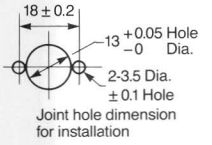
- **Measurement equipment.**
- **Medical equipment.**
- **Paper thickness measurement.**

DIMENSIONS: mm

LP05D3G1AA

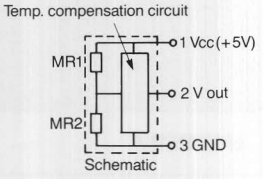


MOUNTING HOLE DIMENSIONS



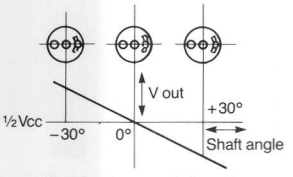
Joint hole dimension for installation

SCHEMATIC DIAGRAM



Schematic

OUTPUT VOLTAGE vs. SHAFT ANGLE



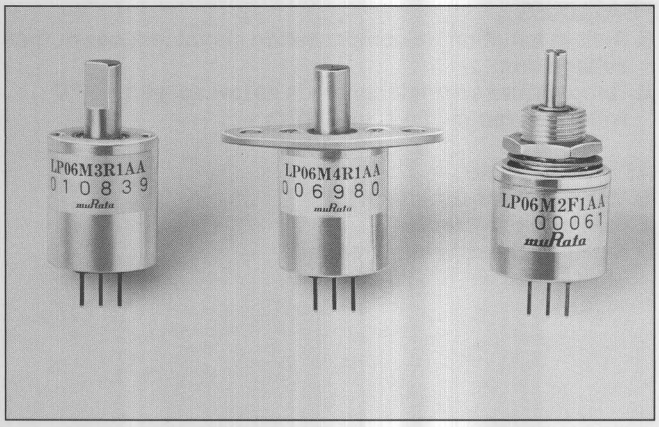
Output voltage vs. shaft angle

SPECIFICATIONS

Item	Unit	Condition	LP05D3G1AA
Supply (Vcc) Voltage	V		5
Total Resistance	KΩ	at +25°C	2 to 10
Effective Linearity Range	deg.	Centered at ½Vcc	±30
Sensitivity	mV/deg.	Vcc=5V, at +25°C	12±2.4
Individual Linearity	%	Within effective linearity range	Max. ±1.5
Temperature Coefficient	%/°C	0°C to +50°C	±0.12
Maximum Rotation Torque	gf • cm	at +25°C	Max. 0.5
Maximum Shaft Load	kg	Thrust Radial	1
Weight	g		26
Operating Temperature	°C		−10 to +60

MAGNETIC ANGLE SENSOR

LP06M SERIES



FEATURES

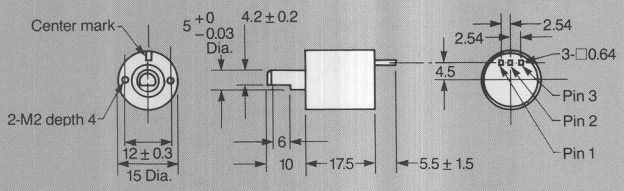
- Compact size and light weight.
- Three different mounting types are available:
  LP06M2F1HA : Bushing mount type.
  LP06M3R1HA : Screw mount type.
  LP06M4R1HA : Flange mount type.
- Terminal pins : Wire-wrap 0.1″ spacing.
- LP06M2F1HA has small rotation torque of 0.5gf/cm.
- Long life.
- All moving parts are made of metal for precision and high reliability.

APPLICATIONS

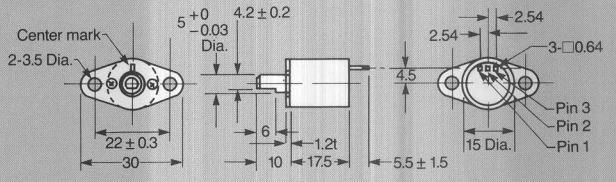
- Tape tension controller for magnetic tape recoder.
- Thickness measurement of paper.
- Angle measurement of valves.
- Detection of fluid levels.

DIMENSIONS: mm

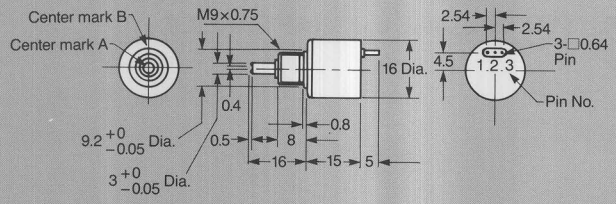
LP06M3R1HA



LP06M4R1HA



LP06M2F1HA



Item	Unit	Condition	LP06M2F1HA	LP06M3R1HA LP06M4R1HA
Supply Voltage (Vcc)	V		6	6
Total Resistance	KΩ	at +25°C	3.5 to 10	3.5 to 10
Effective Linearity Range	deg.	Centered at ½Vcc	±50	±50
Sensitivity	mV/deg.	Vcc=6V, at +25°C	22±6	22±6
Individual Linearity	%	Within effective linearity range	Max. ±1.5	Max. ±1.5
Temperature Coefficient	%/°C	0°C to +50°C	−0.50 to −0.15	−0.50 to −0.15
Insulation Resistance	MΩ	500VDC	Min. 500	Min. 500
Insulation Voltage		500VAC, for one minute	No significant damage	
Maximum Rotation Torque	gf•cm	at +25°C	Max. 0.5	Max. 5
Maximum Shaft Load	kg	Thrust Radial	0.5	1
Weight	g		10	10 (LP06M3R1HA) 12 (LP06M4R1HA)
Operating Temperature	°C		−10 to +80°C	−10 to +80°C

MAGNETIC ANGLE SENSOR

muRata ERIE

LP06M SERIES

PRINCIPLE OF OPERATION

CONSTRUCTION

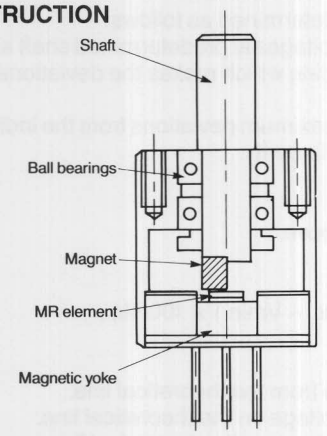


Fig. 1

SHAFT ANGLE vs. OUTPUT VOLTAGE

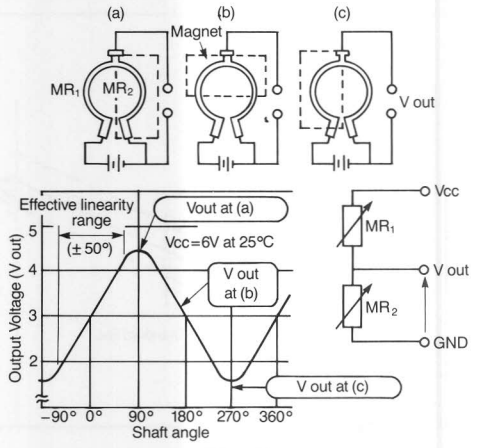


Fig. 2

Fig. 1 shows the construction of the magnetic angle sensor. A magnet is mounted on the end of a rotating shaft. When the shaft rotates, the magnetic field applied to the magnetoresistive (MR) elements varies and a quasi-sine wave signal can be obtained.

In the range near the center of the amplitude of the signal, the output changes linearly. The rotational angle is therefore converted into the output voltage linearly.

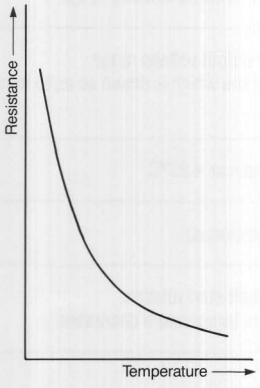
The magnetic yoke is placed opposite the magnet in order to generate a parallel magnetic field and the MR elements are positioned at the center of the magnetic yoke.

A suitable space gap is maintained between the magnet and the MR elements. The magnet is made of rare earth metals having a high energy product.

The rotating shaft is supported with two miniature bearings so that it can rotate smoothly. The life of this sensor depends on these bearings, and long life performance is guaranteed by a high precision assembly.

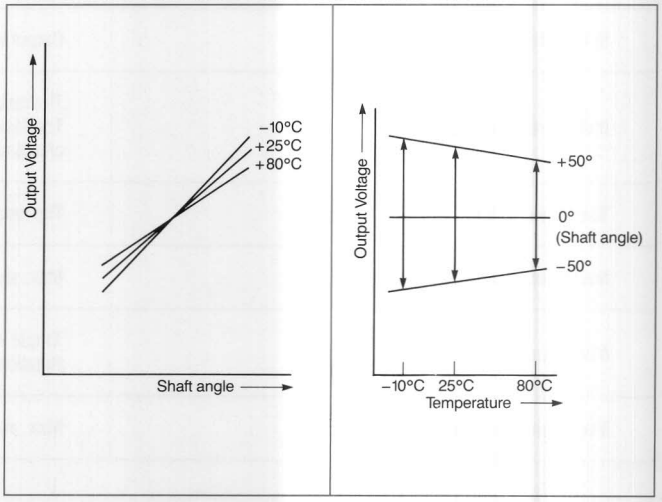
Fig. 2 shows the relationship between the magnet and the MR elements positions, the sensor's equivalent circuit, and the relationship between the angle of rotation and the output voltage.

TEMPERATURE CHARACTERISTICS (Total Resistance)



Total resistance has negative temperature coefficient characteristics.

OUTPUT VOLTAGE vs. TEMPERATURE



TEMPERATURE COEFFICIENT CALCULATIONS

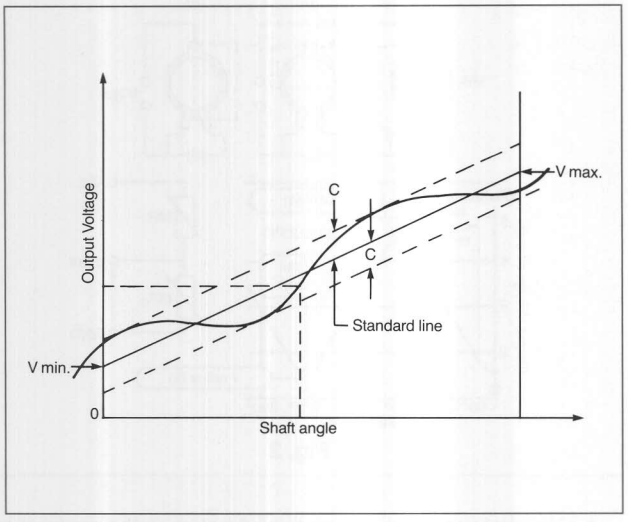
Equation: $\frac{V(t1)-V(t2)}{V(t)} \div (t1-t2) \times 100$

t1 : Max. temp. within operating temp.
t2 : Min. temp. within operating temp.
t : +25°C as standard temp.
V(t) : Output voltage at t°C when the shaft angle is maximum within the effective linearity range.

Example (LP06M series)
t1 : +80°C
t2 : −10°C
t : +25°C
V(t) : Output voltage when ambient temp. is t°C and the shaft angle is +50deg.
+50deg. is Max. value of the effective linearity range.

$\frac{V(+80°C)-V(-10°C)}{V(+25°C)} \div \{+80°C-(-10°C)\} \times 100 = -0.4\%/°C$
(Max. value)

INDIVIDUAL LINEARITY



Individual linearity is determined as follows:
1. Determine output voltages at predetermined shaft angles.
2. Calculate standard line which makes the deviations minimum.
3. Percentage of the maximum deviations from the individual standard line is the linearity.

Fig. 3 illustrates the above.

Linearity = C ÷ (Vmax. – Vmin.) × 100(%)

C : Max. deviation from the theoretical line.
Vmax. : Max. output voltage on the theoretical line.
Vmin. : Min. output voltage on the theoretical line.

DEFINITIONS

Supply Voltage (Vcc)	Maximum voltage which can be applied to the sensor at the rated operating temperature.
Total Resistance	The resistance between Vcc and GND pin when the output voltage is one half of supply voltage (Vcc) by adjusting the shaft rotation angle position.
Effective Linearity Range	Angle range guaranteed linearity.
Sensitivity	Output voltage change per degree in the effective linearity range.
Individual Linearity	The ratio of Max. deviation to the rated output voltage range. The Max. deviation is measured from a line which is drawn so as to minimize the deviation of actual output line.
Temperature Coefficient	The ratio of output drift to standard output at +25°C.
Maximum Rotation Angle	Max. shaft rotation angle. 360deg. (continuous).
Maximum Rotation Torque	Torque which is required to make the shaft start rotation. Rotation torque increases when ambient temperature decreases.
Maximum Shaft Load	Max. allowable load to the shaft.

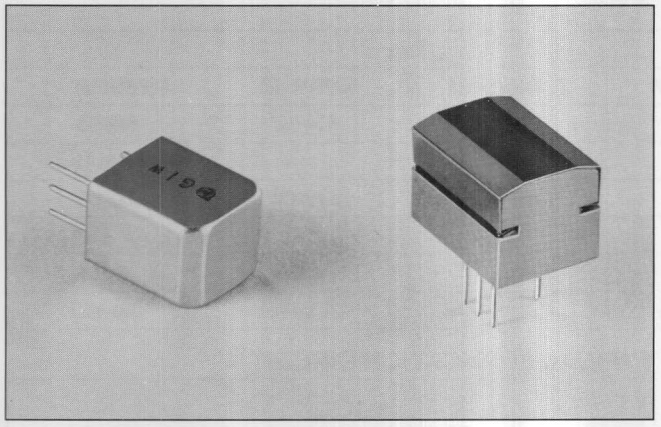
APPLICATION NOTES

1. Prevent mechanical shock. Any damage to the incorporated ball bearings may cause malfunction.
2. Do not overload the shaft.
3. The use of a flexible joint is recommended.

MAGNETORESISTIVE CURRENCY RECOGNITION SENSOR

muRata ERIE

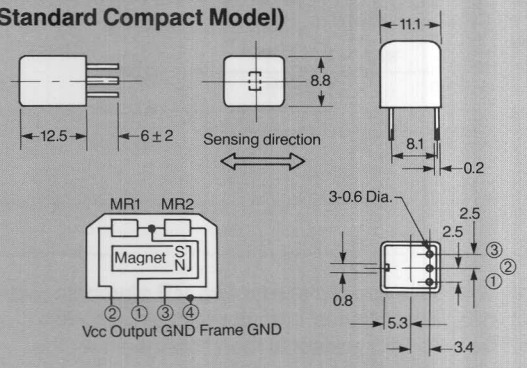
BSO5 SERIES



Murata Erie's Currency Recognition Sensor utilizes single crystal, InSb technology to obtain a sensor with a very high magnetoresistive (MR) effect. It senses the magnetic print of currency to produce a sinusoidal output voltage that is not influenced by the scanning speed to obtain currency recognition.

DIMENSIONS: mm

BS05N1HGAA/BS05NHFAA (Standard Compact Model)



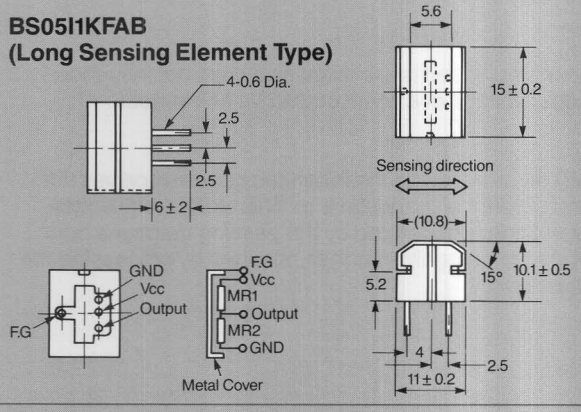
FEATURES

- High sensitivity and excellent gap characteristics.
- Magnetoresistive sensor provides excellent response frequency characteristics and is independent of scanning speed.
- Compact size and light weight.
- Hermetically sealed construction for excellent environmental characteristics.

APPLICATIONS

- Bank currency validator.
- Magnetic ink document reader.
- Magnetic tape reader.
- Magnetic gear detector.

BS05I1KFAB (Long Sensing Element Type)



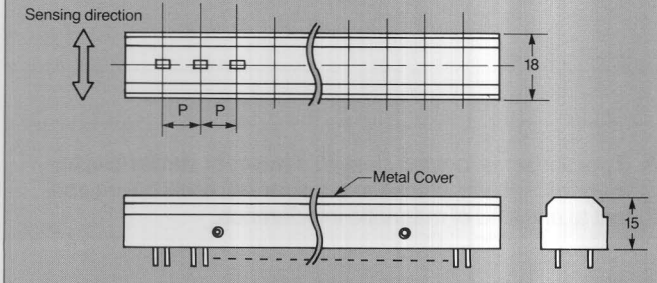
FEATURES

- Sensor has an extra wide track to read magnetic-ink characters over an extensive area.
- Sensor can tolerate wide variance in scanning position.
- Sensor surface is made of a special metal which is very resistant to wear. Therefore, it is ideal for use in high speed machines such as bank note counters.
- High sensitivity and excellent frequency response characteristics.

APPLICATIONS

- Bank currency validator.
- Magnetic ink document reader.

BS05M1HF (Multichannel Sensor)



FEATURES

- Multiple magnetic information can be read simultaneously.
- Customers can specify the number of channels and the pitch between channels.
- Assembly is simple and the channel pitch can be narrower than with individual sensors.
- Excellent gap and frequency response characteristics.
- Special wear-resistant metal is applied to the sensor surface.

APPLICATIONS

- Bank currency validator.
- Pattern recognition of magnetic ink printing.
- High speed bank note counter.

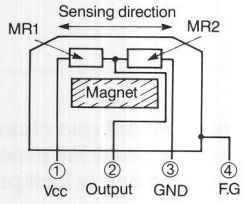
MAGNETORESISTIVE CURRENCY RECOGNITION SENSOR

BS05 SERIES

SPECIFICATIONS

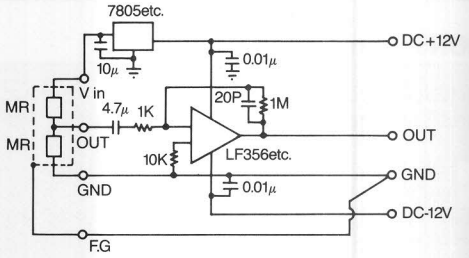
Item	Unit	Type			
		BS05N1HGAA	BS05N1HGFAA	BS05I1KFAB	BS05M1HF□□
Supply Voltage (Vcc)	V	5.0±0.5	5.0±0.5	5.0±0.5	5.0±0.5
Total Resistance (at 25°C)	KΩ	0.75 to 4.5	0.75 to 4.5	1 to 6	0.6 to 4.5
Output Voltage (at 25°C)	mV(rms)	235 min.	400 min.	0.3 to 0.8	250 min.
Detection Width	mm	3	3	10	3
Resolution	mm	0.75	0.75	0.75	0.75
Operating Temperature Range	°C	−20 to +60	−20 to +60	−20 to +60	0 to +50

TYPICAL CONSTRUCTION

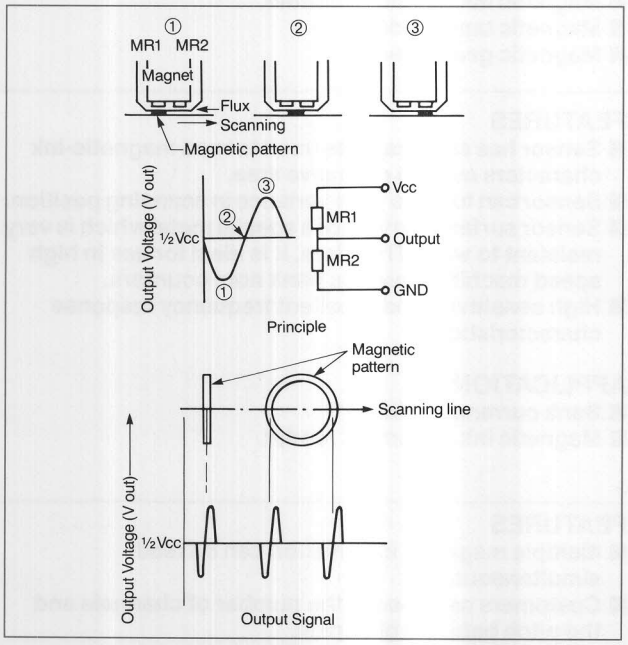


Magnetoresistive currency recognition sensor consists of a pair of magnetoresistive elements and a magnet. (MR stands for Magnetoresistive element.)

TYPICAL APPLICATION CIRCUIT



PRINCIPLE OF OPERATION



The supply voltage is applied across two MR elements and the output voltage is obtained from the middle of the two elements. The magnetic sensor is then scanned over the printed magnetic pattern.

The scanning speed is irrelevant as it does not influence the output voltage of a semiconductive MR sensor.

The MR element facing the magnetic pattern receives the greatest amount of magnetic flux. Therefore, a sinusoidal output voltage is generated by the passing magnetic print. The currency recognition is then obtained by processing the output pattern.

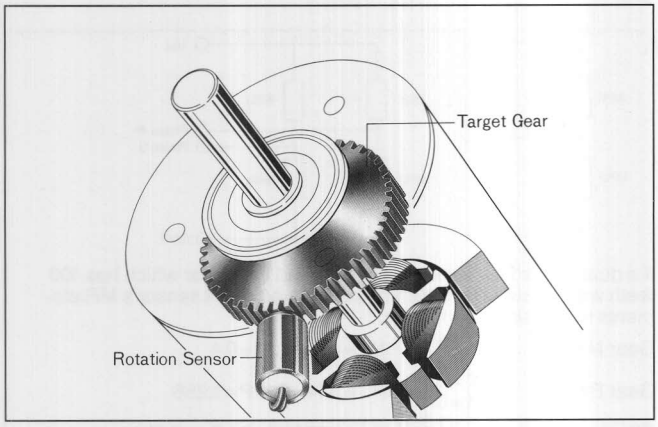
APPLICATION NOTES

1. Sensor surface should be free of magnetic dust.
2. Keep sharp objects away from sensing surface.
3. If the sensor is located close to a motor or similar electromagnetic device, please make sure that it will not be subject to any kind of magnetic interference.

ROTATION SENSOR

muRata ERiE

FR SERIES



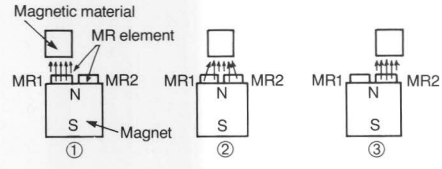
Murata Erie's FR Series rotation sensors are compact, high performance sensors featuring semiconductor magnetoresistors.

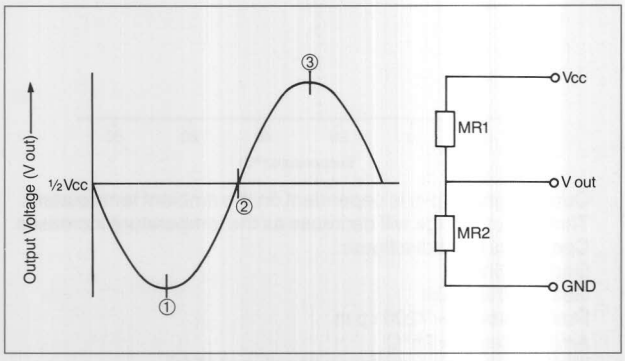
FEATURES

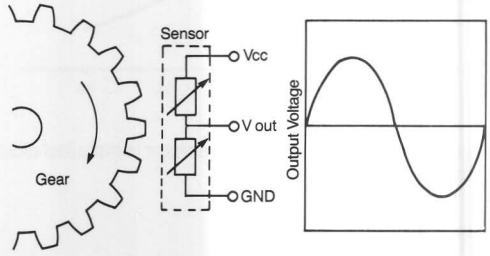
- **Semiconductive magnetoresistors and a permanent magnet.**
- **FR sensor detects the position and the speed of a gear over a wide range of frequencies even at a complete stop.**
- **Non-contact sensing mechanism guarantees long life.**
- **Rugged and reliable. Suitable for motor control for Factory Automation.**
- **Variety of applications are possible with multiphase type.**

PRINCIPLE OF OPERATION:

As magnetic material passes over the sensing surface, the magnetic flux distribution across the magnetoresistors varies. This variance causes a change in the elements resistance and produces an output signal. Therefore, when it is placed close to the magnetic gear as shown in Fig. 2, the sensor outputs a signal synchronized to the gear's rotation. The count of the output signal's peaks is equal to the number of gear teeth passing over the sensor.





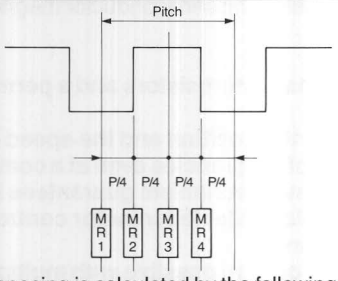


TYPICAL APPLICATIONS

Part Number	Output Type	Motion		Gear Module	Gear Pitch (mm)
		Rotational	Linear		
FR05CM21AR	Single	△	○	M = 0.3 to 1.0	P = 0.9 to 3.1
FR05CM12AL	Dual	○	△	M = 0.4	P = 1.3
FR05CM62AF	Dual with Reference	○	△	M = 0.4	P = 1.3
FR12AM32AC	Dual, Digital	△	○	M = 0.635	P = 2.0
FR05CM14AD	Quad	○	△	M = 0.4	P = 1.3

○ : Best suited, △ : Suitable

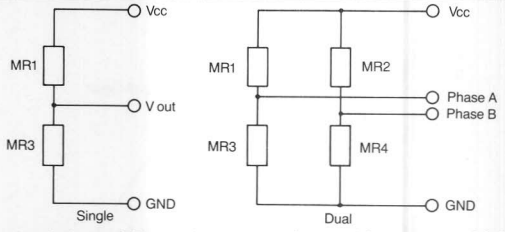
GEAR PITCH AND ELEMENT SPACING



Element spacing is calculated by the following formula:

Se = P/2N
P = π×M where,
M = D/Z

Se : Element spacing
P : Gear pitch
N : Number of output phase
M : Gear module
D : Gear diameter
Z : Number of gear teeth



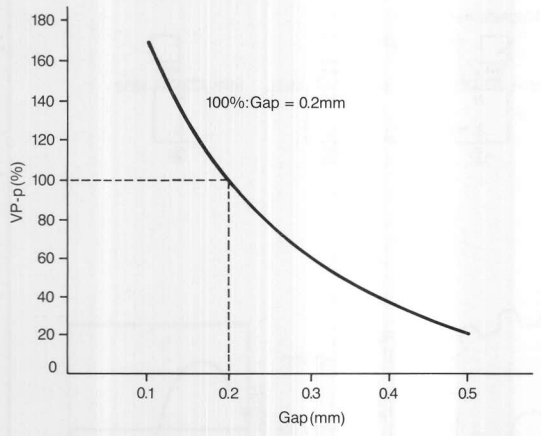
Example: If a dual phase FR rotation sensor is used for a gear which has 100 teeth with a diameter of 40mm, the spacing of FR sensor's MR elements is calculated as follows:

Gear Module : D = 40, Z = 100 : M = 40/100 : M = 0.4

Gear Pitch : π = 3.14, M = 0.4 : P = 3.14×0.4 : P = 1.256

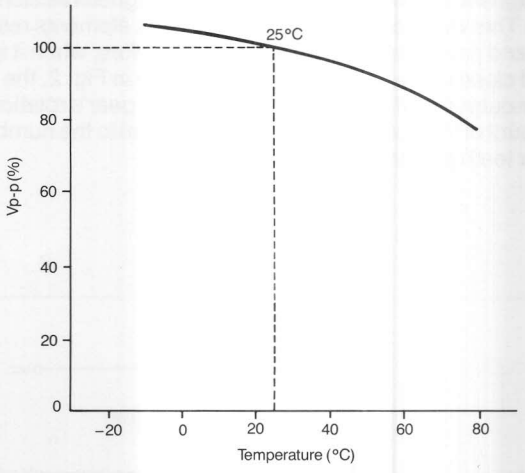
Element Spacing : P = 1.256, N = 2 : Se = 1.256/(2×2) : Se = 0.314mm

TYPICAL GAP CHARACTERISTICS



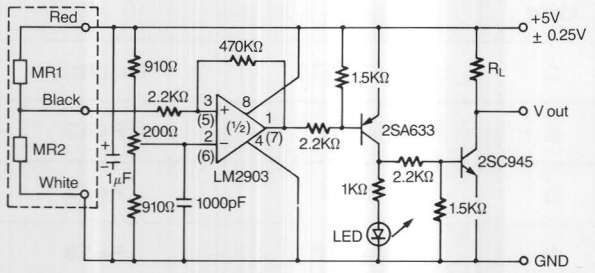
Large signals are obtained when FR sensor is installed closest to the target gear.

TYPICAL TEMPERATURE CHARACTERISTICS



Output signal, Vp-p is dependent on the ambient temperature. This output voltage will decrease as the temperature increases.
Conditions for above figure:
Gap = 0.15mm
Gear module = 0.4
Rotation speed = 7200 r.p.m.
Ambient temp. = 25°C
Vertical scale is normalized with value at 25°C

TYPICAL APPLICATION CIRCUIT



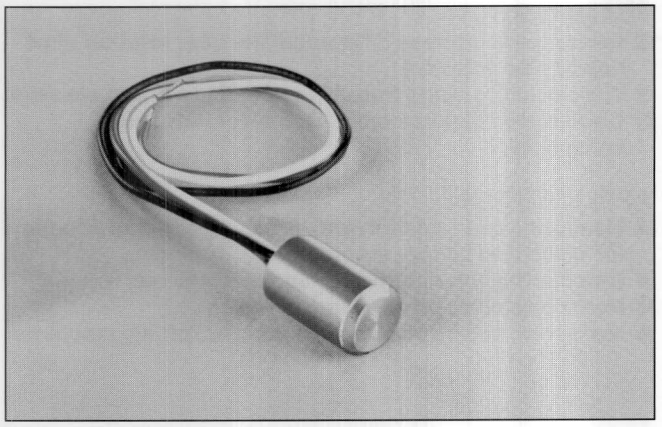
APPLICATION NOTES

- Do not subject the sensing surface to mechanical shock.
- Keep the sensing surface away from magnetic dusts.
- Do not place any magnetic materials around the sensing surface except the target gear.
- Align the sensor properly to the gear.

ROTATION SENSOR
SINGLE PHASE

muRata ERIE

FR05CM21AR



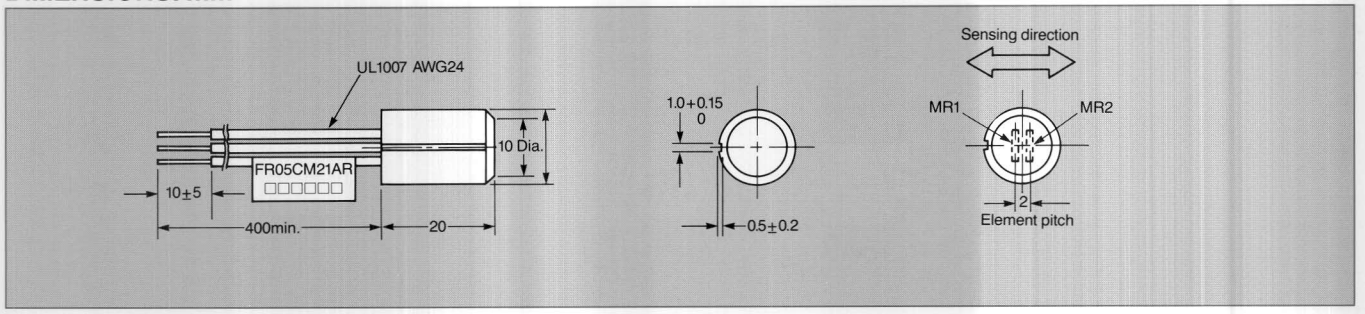
FEATURES

- Sensing over wide range of rotation speed including at a complete stop.
- Compact package and light weight.
- Simple installation by easy adjustment of signal output and gap distance.
- Best suited for harsh environments.

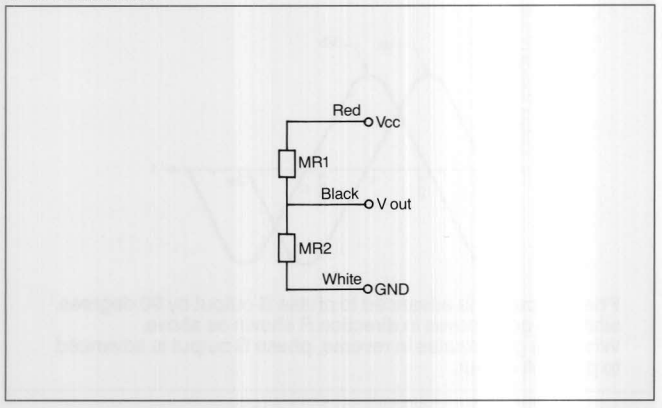
APPLICATIONS

- Rotation speed detection for office and factory automation.
- Rotation position detection.
- Contactive switch.

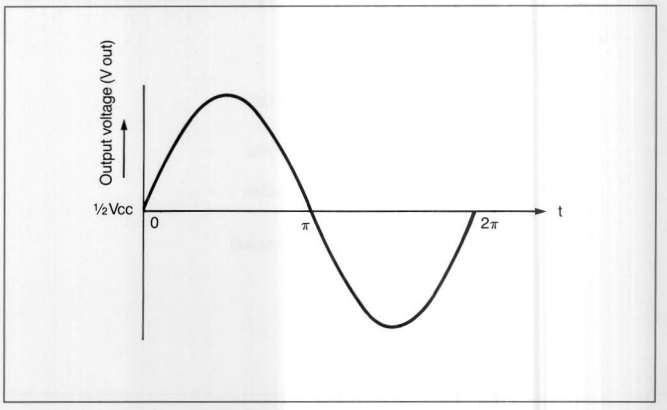
DIMENSIONS: mm



SCHEMATIC



OUTPUT WAVE FORM

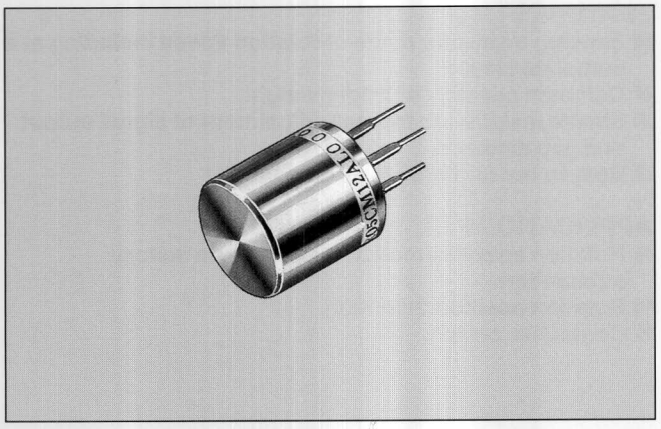


SPECIFICATIONS

Item	Unit	FR05CM21AR
Supply Voltage (Vcc)	V	Max. 5.5
Output Voltage (peak to peak)	V	Min. 0.5 at +25°C, Gap=0.2mm
Response Frequency	KHz	0 to 100
Total Resistance	KΩ	0.7 to 1.5
Operating Temperature	°C	−10 to +70
Target Gear Module		0.3 to 1.0

ROTATION SENSORS
DUAL PHASE

FRO5CM12AL



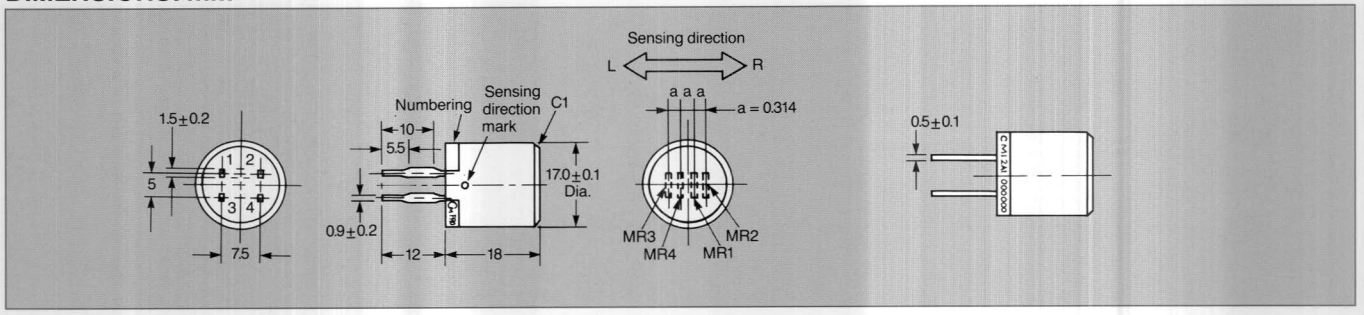
FEATURES

- **By comparing phase difference, the gear rotation direction can be detected.**
- **Wide sensing range from high speed to a complete stop.**
- **Good signal to noise ratio; high resolution; high sensitivity.**

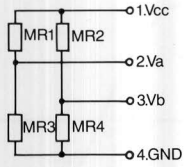
APPLICATIONS

- **Measuring gear rotation and detecting rotation direction for office and factory automation.**
- **Detection of the direction of linear motion servo.**
- **Motor controller for vehicles.**
- **Measuring needle position in industrial knitting machines.**

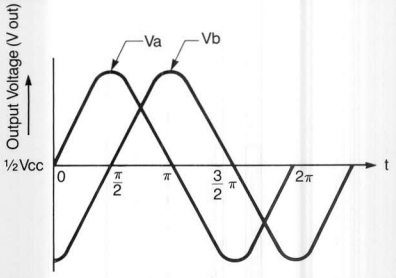
DIMENSIONS: mm



SCHEMATIC



OUTPUT WAVE FORM



Phase A output is advanced to phase B output by 90 degrees while the gear moves in direction R shown as above.
When the gear rotates in reverse, phase B output is advanced to phase A output.

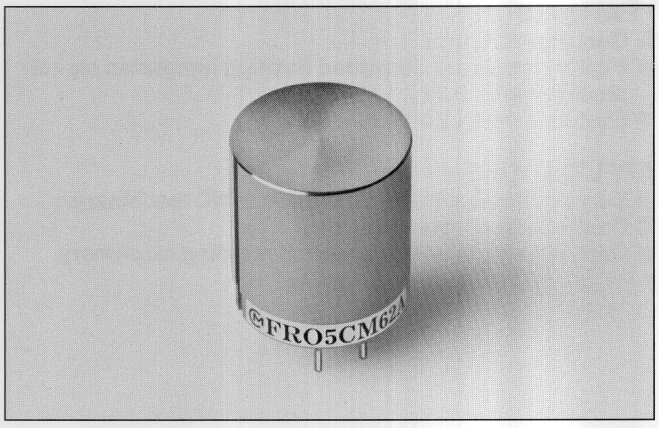
SPECIFICATIONS

Item	Unit	FR05CM12AL
Supply Voltage (Vcc)	V	Max. 5.5
Output Voltage (peak to peak)	V	Min. 0.45 at +25°C, Gap=0.15mm
Response Frequency	KHz	0 to 100
Total Resistance	KΩ	0.2 to 1.0
Operating Temperature	°C	−10 to +80
Target Gear Module		0.4
Phase Difference	deg.	90±5

ROTATION SENSORS
DUAL PHASE WITH REF. VOLTAGE

muRata ERIE

FRO5CM62AF



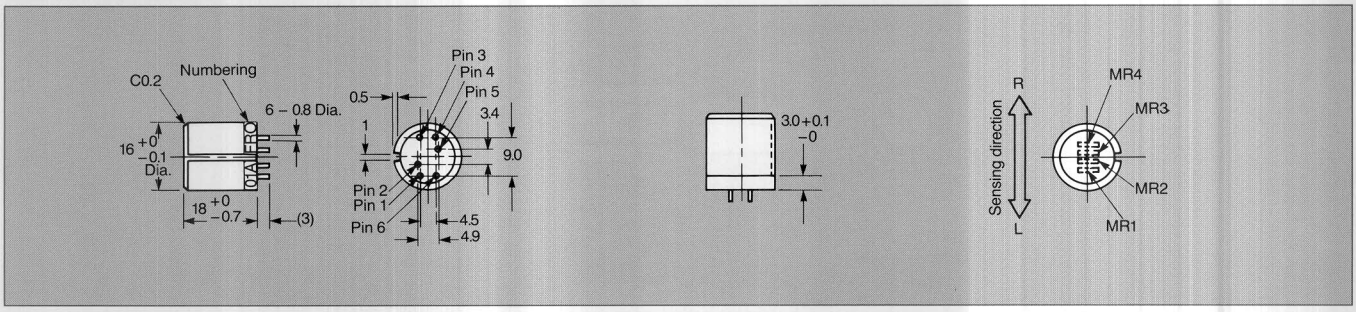
FEATURES

- Reference voltage outputs are used as threshold voltages to comparator.
- By comparing the phase difference, the gear rotation direction is detected.
- Signal to noise ratio is constant over wide rotation frequency.

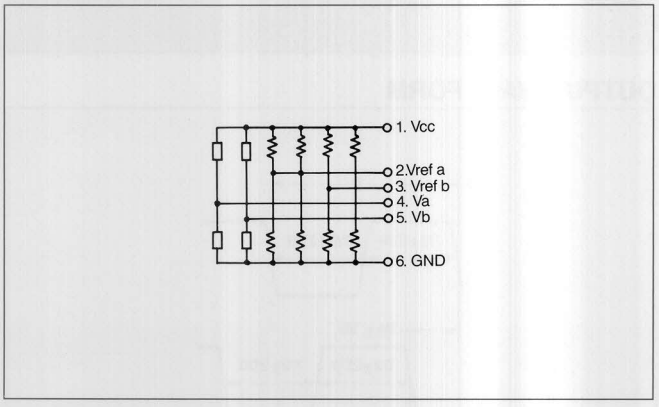
APPLICATIONS

- Measuring gear rotation and detecting rotation direction for office and factory automation.
- Controller for servo motor in NC machinery.

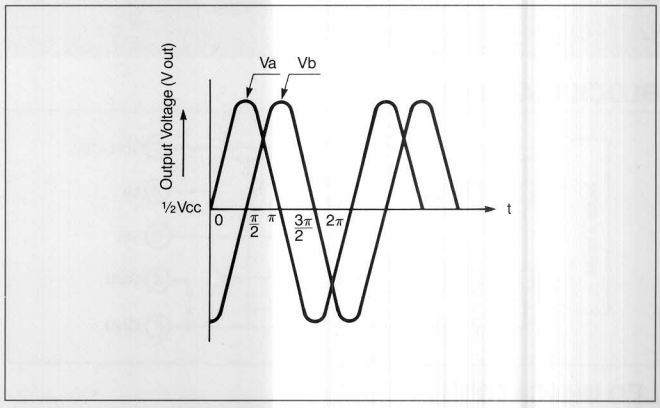
DIMENSIONS: mm



SCHEMATIC



OUTPUT WAVE FORM

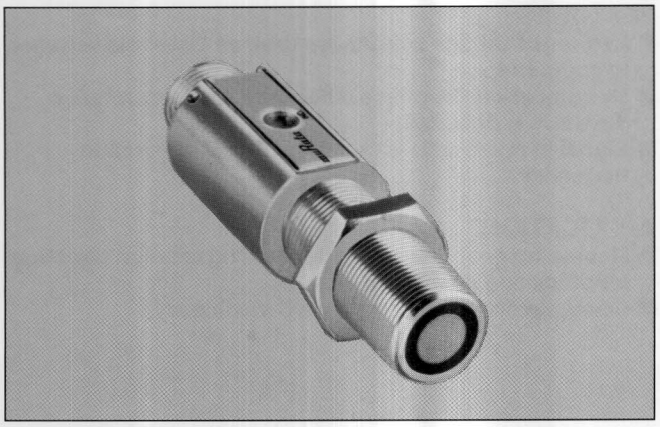


SPECIFICATIONS

Item	Unit	FR05CM62AF
Supply Voltage (Vcc)	V	Max. 5.5
Output Voltage (peak to peak)	V	0.35 to 0.6 Gap=Max. 0.3mm
Response Frequency	KHz	0 to 100
Total Resistance	KΩ	0.2 to 1.2
Operating Temperature	°C	−10 to +80
Target Gear Module		0.4
Phase Difference	deg.	90±5

ROTATIONAL SENSOR
DUAL PHASE
DIGITAL OUTPUT

FR12AM32AC



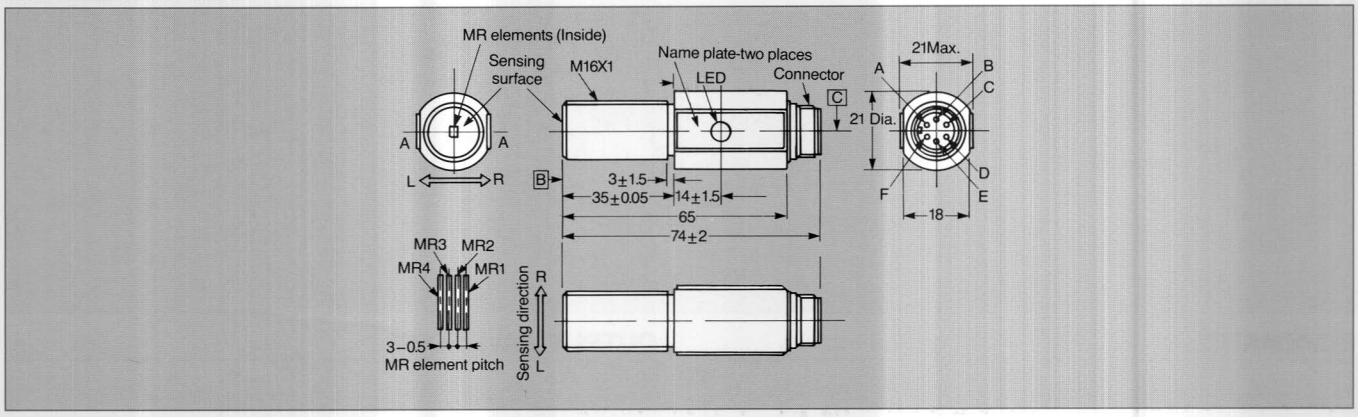
FEATURES

- **Dual digital output.**
- **Digital signals are outputted through integrated signal processing circuitry.**
- **Equipped with LED indicators.**

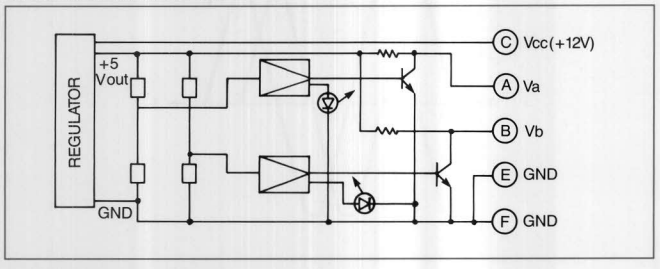
APPLICATIONS

- **Servo controller for linear motion of NC machinery.**
- **Controller for robot arms.**
- **Controller for injection speed of molding machinery.**

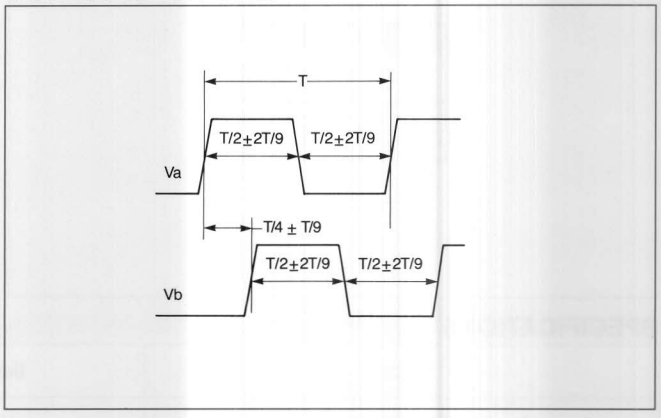
DIMENSIONS: mm



BLOCK DIAGRAM



OUTPUT WAVE FORM



LED INDICATORS

Output	Va	High	Low	Low	High
	Vb	High	High	Low	Low
LED Illumination		Off	Red	Orange	Green

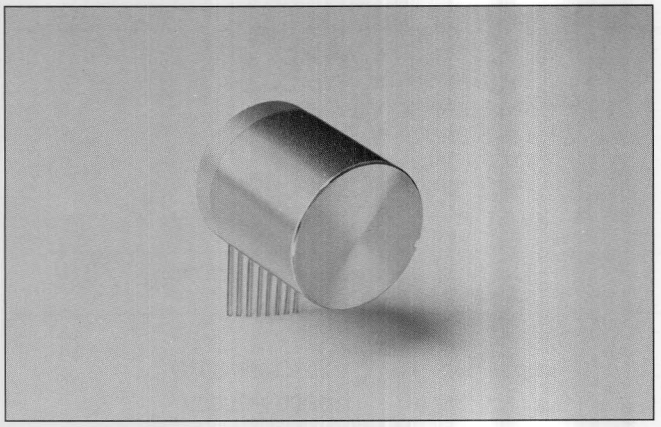
SPECIFICATIONS

Item		Unit	FR12AM32AC
Supply Voltage (Vcc)		V	12±2
Output Voltage at +25°C, Gap = Max. 0.3mm	High	V	Min. 4.5
	Low		Max. 0.5
Current Consumption		mA	Max. 100
Response Frequency		KHz	0 to 20
Total Resistance		Ω	330±33
Operating Temperature		°C	−10 to +70
Target Gear Module			0.635
Phase Difference		deg.	90±40

ROTATIONAL SENSOR
QUAD PHASE
WITH ZERO POSITION

muRata ERIE

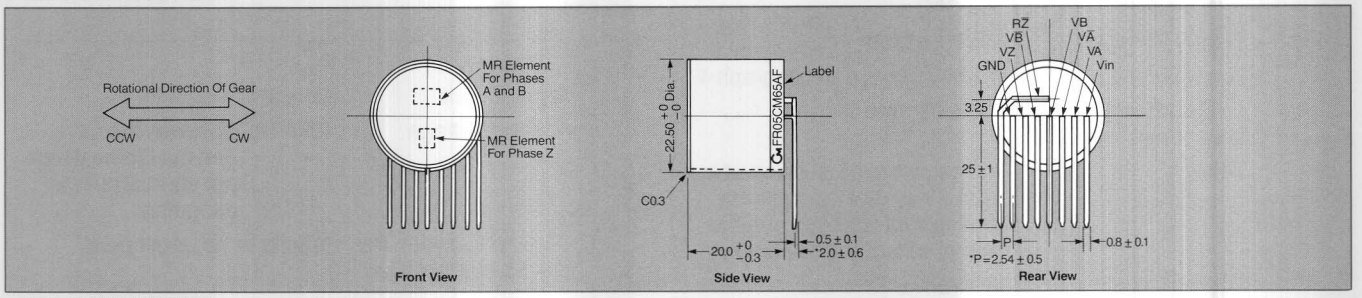
FRO5CM65AF



FEATURES

- **In combination with a reference gear, phase Z for sensing home position can be obtained.**
- **Lower cost than using two sensors.**
- **Higher accuracy can be expected.**

DIMENSIONS: mm



SPECIFICATIONS

Item	Symbol	Value	Condition
Maximum Rated Voltage	V max.	5.25 V	
Supply Voltage	V_{cc}	5.0V±5%	
Operating Temp. Range	T min./T max.	−10°C to +80°C	
Storage Temp. Range	T_s	−40°C to +120°C	
Humidity Range	RH	20% to 95%	
Input Resistance	R_0	100 to 1000Ω	*1
Neutral Voltage	V_0A(CW), V_0A(CCW) $V_0\bar{A}$(CW), $V_0\bar{A}$(CCW) V_0B(CW), V_0B(CCW) $V_0\bar{B}$(CW), $V_0\bar{B}$(CCW) V_0Z(CW), V_0Z(CCW) (Note 1)	2.500±0.500V	*2
	$R_0\bar{Z}$ (Note 2)	2.500±0.025V	
Difference Between Clockwise and Counter-Clockwise Neutral Voltages	V_0A(CW)−V_0A(CCW) $V_0\bar{A}$(CW)−$V_0\bar{A}$(CCW) V_0B(CW)−V_0B(CCW) $V_0\bar{B}$(CW)−$V_0\bar{B}$(CCW)	0±30mV	*2
	V_0Z(CW)−V_0Z(CCW)	0±40mV	
Peak-To-Peak Output Voltage	Vp-pA, Vp-p$\bar{A}$ Vp-pB, Vp-p$\bar{B}$	300mV min.	*2
	Vp-pZ	700mV min.	
Ratio of Peak-To-Peak Output Voltages	d (Note 3)	1.00±0.15	*2
Phase Difference	Between Vp-pA and Vp-pB	90±5°	*2
	Between Vp-p$\bar{A}$ and Vp-p$\bar{B}$	90±5°	
	Between Vp-pA and Vp-p$\bar{A}$	180±10°	
	Between Vp-pB and Vp-p$\bar{B}$	180±10°	
Temperature Drift of Neutral Voltages	$\triangle_{\tau D}V_0A$, $\triangle_{\tau D}V_0B$ $\triangle_{\tau D}V_0\bar{A}$, $\triangle_{\tau D}V_0\bar{B}$	0±100mV (Note 4)	*3
	$\triangle_{\tau D}V_0Z$	0±40mV (Note 4)	
	$\triangle_{\tau D}R_0\bar{Z}$	0±10mV (Note 4)	
Temperature Drift Difference Between Neutral Voltages	$\triangle_{\tau D}V_0A-\triangle_{\tau D}V_0\bar{A}$ $\triangle_{\tau D}V_0B-\triangle_{\tau D}V_0\bar{B}$	0±100mV	*3
	$\triangle_{\tau D}V_0Z-\triangle_{\tau D}R_0\bar{Z}$	0±50mV	
Insulation Resistance	IR	500MΩ min.	*4

ROTATIONAL SENSOR
QUAD PHASE
WITH ZERO POSITION

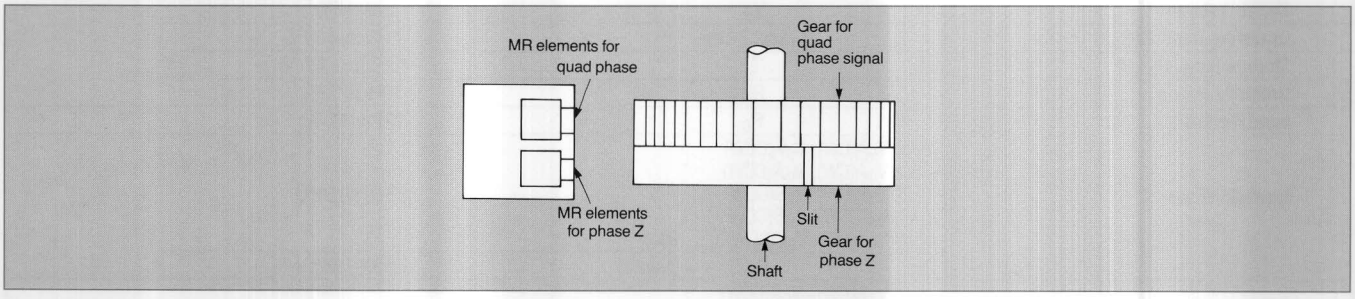
FRO5CM65AF

NOTES

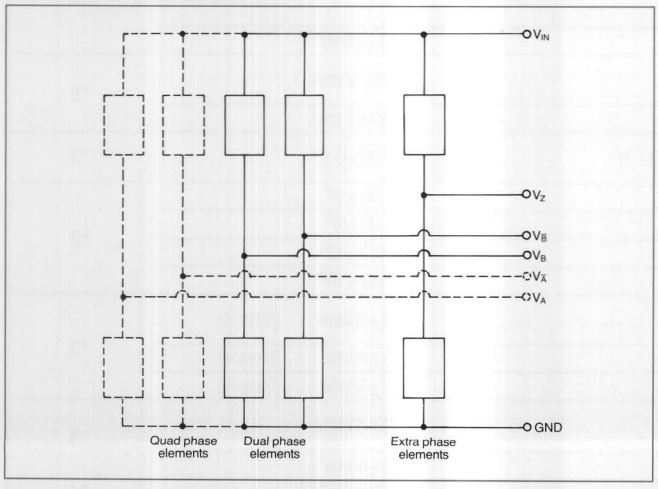
1. V_0A(CW) is the neutral voltage of phase A with the target gear rotating clockwise.
2. $R_0\overline{Z}$ is actually the reference voltage for phase Z.
3. $$d=\frac{Vp\text{-}pA+Vp\text{-}p\overline{A}}{Vp\text{-}pB+Vp\text{-}p\overline{B}}$$
4. $\triangle_{TD}V_0A = V_0A(80°C) - V_0A(25°C)$
   $\triangle_{TD}V_0\overline{A} = V_0\overline{A}(80°C) - V_0\overline{A}(25°C)$
   $\triangle_{TD}V_0B = V_0B(80°C) - V_0B(25°C)$
   $\triangle_{TD}V_0\overline{B} = V_0\overline{B}(80°C) - V_0\overline{B}(25°C)$
   $\triangle_{TD}V_0Z = V_0Z(80°C) - V_0Z(25°C)$
   $\triangle_{TD}R_0\overline{Z} = R_0\overline{Z}(80°C) - R_0\overline{Z}(25°C)$

*1	Temperature	: 25 ± 3°C
	Air Gap Between the Sensor and the Gear	: Infinite or no target gear
*2	Temperature	: 25 ± 3°C
	Supply Voltage	: 5.000 ± 0.002V
	Target Gears	: As per drawings at paragraph 4
	Air Gap Between the Sensor and the Gear	: 0.15 ± 0.01mm
	Setting	: The sensor to be positioned in such a way that the peak-to-peak output voltages and the neutral voltages are optimized.
	Rotation Speed	: 1500rpm ± 10%
*3	Temperature	: 25°C and 80°C
	Supply Voltage	: 5.000 ± 0.002V
	Air Gap Between the Sensor and the Gear	: Infinite or no target gear
*4	Temperature	: 25 ± 3°C
	Applied Voltage	: 250VDC Between the case and the 8 pins which are shortcircuited altogether
	Air Gap Between the Sensor and the Gear	: Infinite or no target gear

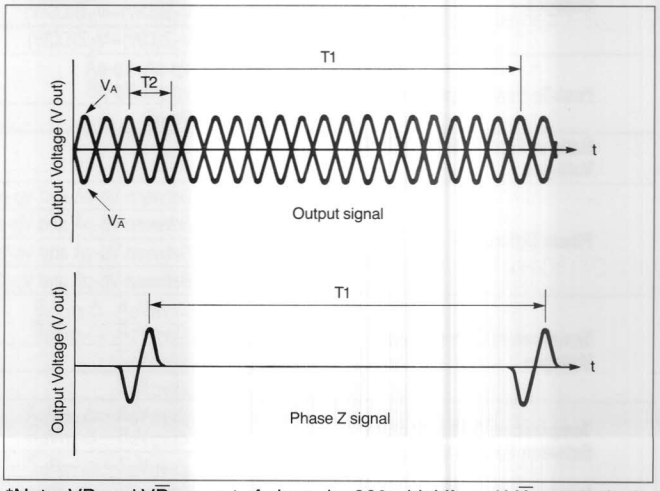
TYPICAL CONSTRUCTION



TYPICAL SCHEMATIC



TIMING



*Note: VB and $V\overline{B}$ are out of phase by 90° with VA and $V\overline{A}$ respectivelv.

APPLICATION QUESTIONNAIRE

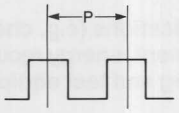
If the standard products for rotational sensors do not meet your applications requirements, please fill out the questionnaire below and contact the local sales office in your area.

■ ELECTRICAL SPECIFICATIONS

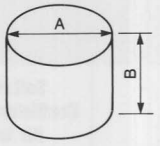
1. Output Type: ☐ Analog ☐ Digital
2. Output Phases: ☐ Single ☐ Dual
   ☐ Quad ☐ with Z Phase
3. Output Signal Level: _____ mVp-p
4. Supply Voltage: _____ V
5. Frequency Response: _____ to _____ Hz

■ MECHANICAL SPECIFICATIONS

1. Gear tooth pitch or gear module. : P: _____ mm
   M: _____



2. Air gap between the sensing surface and the gear: _____ mm
3. Sensor size: Diameter (A): _____ mm
   Height (B): _____ mm



■ ENVIRONMENTAL CONDITIONS

1. Operating Temperature: _____ to _____ °C
2. Others: _____

■ ADDITIONAL CONSIDERATIONS

_____

_____

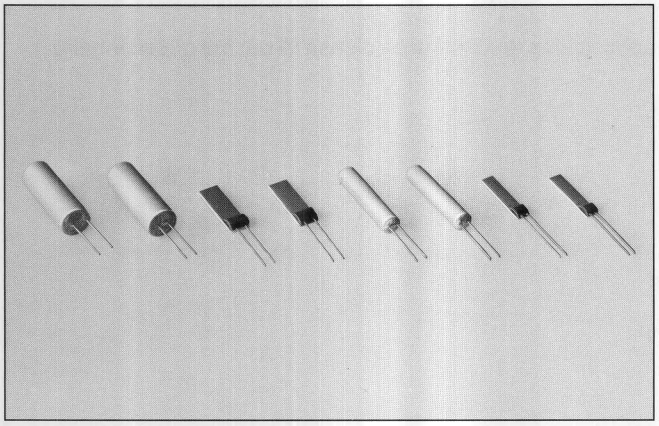
_____

_____

_____

PLATINUM SENSORS FOR TEMPERATURE SENSING

TR SERIES



Platinum has been used for over 100 years as a temperature sensing material, the main reason being the high stability of platinum. Thus, the Pt-Sensor has been adopted as the world standard. Due to systematic improvements in technology Murata Erie is able to offer efficient Pt-Sensors at competitive prices.

FEATURES

- **High reliability**
- **Excellent long-term stability even at temperatures up to 600°C.**
- **Rapid response time**
- **Insensitive to vibration**
- **Insensitive to thermal shock**
- **Tight tolerances**
- **Customized versions available**
- **High efficiency at economical cost**

APPLICATIONS

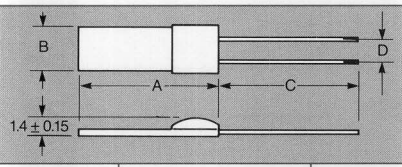
- **Heating and air conditioning**
- **Energy distribution control (heating-cost distribution; heat rating)**
- **Automobile technology**
- **Domestic appliances**
- **Industrial process control applications (e.g. chemical, food manufacturing, heat treatment, energy recuperation)**
- **Portable temperature measuring and test equipment**

PART NUMBERING

TR	F	A	101	B	001
Pt SENSOR	TYPE F=Flat R=Round	SIZE	RESISTANCE VALUE 101=10 • 10'Ω=100Ω	TOLERANCE	SPECIAL TYPES

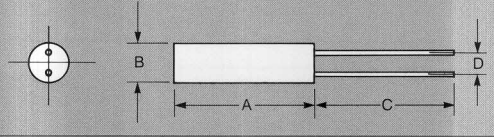
DIMENSIONS AND SPECIFICATIONS

FLAT TYPE



Part Number	Dimensions (mm) A ±0.2	B ±0.15	C ±1	D	Nominal Resistance at 0°C	Response Time Water 0.4m/sec.	τ0.9 Air 1m/sec.	Self Heating Coefficient (°C/mW) Air 1m/sec.
TRFA 101 □ TRFA 501 □ TRFA 102 □	10.0	3.0	10	1.4	100Ω 500Ω 1000Ω	0.5s	50s	0.16°C/mW
TRFB 101 □ TRFB 501 □ TRFB 102 □	10.0	2.0	10	1.0	100Ω 500Ω 1000Ω	0.4s	20s	0.25°C/mW
TRFC 101 □	2.3	2.0	10	1.0	100Ω	0.3s	15s	0.4°C/mW
TRFD 101 □ TRFD 501 □	5.0	2.0	10	1.0	100Ω 500Ω	0.4s	20s	0.25°C/mW
TRFE 101 □ TRFE 501 □ TRFE 102 □	5.0	4.0	10	1.4	100Ω 500Ω 1000Ω	0.4s	25s	0.2°C/mW

ROUND TYPE

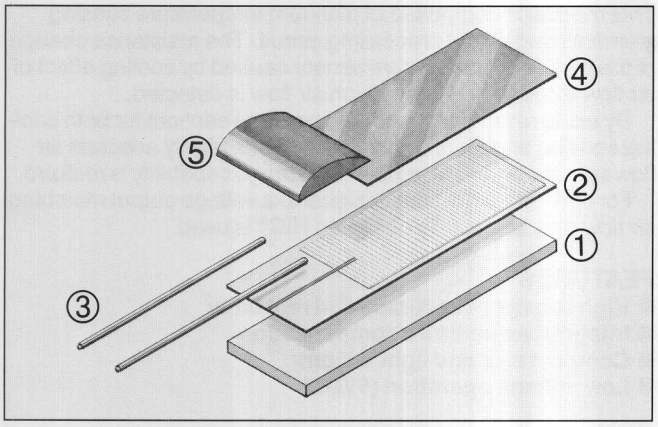


Part Number	Dimensions (mm) A ±0.2	B ±0.15	C ±1	D	Nominal Resistance at 0°C	Response Time Water 0.4m/sec.	τ0.9 Air 1m/sec.	Self Heating Coefficient (°C/mW) Air 1m/sec.
TRRA 101 □ TRRA 501 □ TRRA 102 □	13.0	4.5	8	1.4	100Ω 500Ω 1000Ω	5s	75s	0.11°C/mW
TRRB 101 □ TRRB 501 □ TRRB 102 □	13.0	2.8	8	1.0	100Ω 500Ω 1000Ω	3s	40s	0.20°C/mW

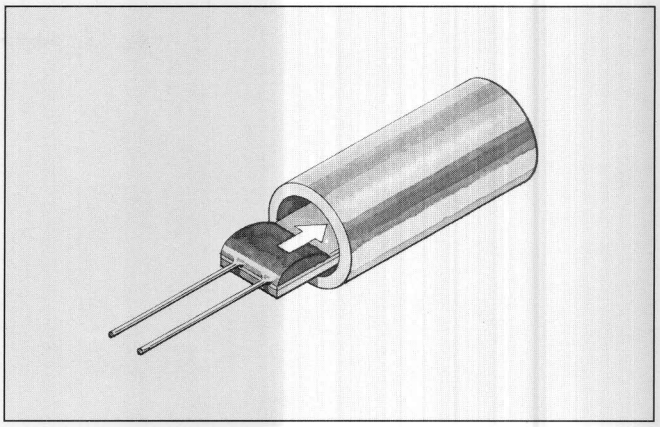
PLATINUM SENSORS FOR TEMPERATURE SENSING

muRata ERIE

TR SERIES



1 = ceramic substrate
2 = platinum film
3 = lead wire (platinum-coated nickel)
4 = glass protection for platinum film
5 = glass protection for lead wires



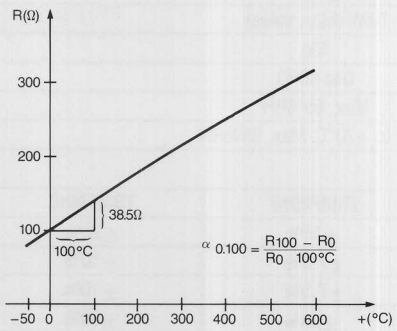
cylindrical version (flat Pt-sensor in ceramic tube)

TECHNICAL DATA

Characteristics meet the requirements of DIN IEC 751
Temp.-Coefficient : 0.00385 K^{-1}
Tolerance Classes : are to DIN IEC 751
Temp. Ranges : −50°C to 600°C
(for class A −50°C to 400°C)

Measuring Principle

Temperature measurement with Pt-sensors is based on the measurement of electrical resistance. The resistance of Pt-sensors constantly varies with temperature in a precisely predetermined fashion. The graph below represents the characteristic of the Pt-sensor.



The relationship between temperature and resistance can be expressed exactly by a mathematical function by which the principle values of the Pt100 resistors can be calculated:

0°C to 600°C:

$Rt = R_0 (1 + 3.90802 \cdot 10^{-3} \cdot t - 0.580195 \cdot 10^{-6} \cdot t^2)$

−50°C to 0°C:

$Rt = R_0 (1 + 3.90802 \cdot 10^{-3} \cdot t - 0.580195 \cdot 10^{-6} \cdot t^2 - 4.27350 \cdot 10^{-12} (t-100) t^3)$

The calculated principle values for Pt 100 can be obtained from the table below.

For characterization of resistance variation with temperature the **temperature coefficient $\alpha_{0.100}$ (= TC)** is used. It indicates the medium relative resistance change according to temperature between 0°C and 100°C.

$$\alpha_{0.100} = \frac{R_{100} - R_0}{R_0 \cdot 100°C}$$

R_0 = resistance at 0°C
R_{100} = resistance at 100°C

For Pt-resistor are to DIN IEC 751:
$\alpha_{0.100} = 0.00385\ °C^{-1}$

Resistance R_0 and temperature coefficient $\alpha_{0.100}$ are used for characterization and enable a clear division into tolerance classes (see table below).

Permissible Deviations:

The following figures express the permissible tolerance deviations of the principle values in dependence on temperature:

Tolerance Class	Limit Deviation (°C)
DIN A	0.15 + 0.002 |t|
DIN B	0.3 + 0.005 |t|
C	0.6 + 0.007 |t|
D	1.5 + 0.015 |t|

Errors Due to Self-Heating

To measure the resistance an electric current has to flow through the element which will generate heat energy resulting in errors of measurement. To minimize this effect the testing current should be kept low (roughly 1 mA). Measurement error due to self-heating (= △T) can be calculated utilizing at first the formula for power N (= $I^2 \times R$) and then the formula for △T = N x S (self-heating control).

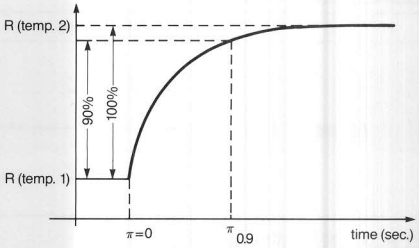
Example:
R = 500Ω, I = 1 mA, s = 0.16 °C/mW
N = (1 mA)² • 500Ω = 0.5 mW
△t = 0.5 mW • 0.16 °C/mW = 0.08 °C

Insulation Resistance

To avoid errors in measurement due to creepage it is necessary to have very good electric insulation between the junction wires.

Response Time

The response time $t_{0.9}$ is the time the sensors need to respond to 90% of the change in temperature.

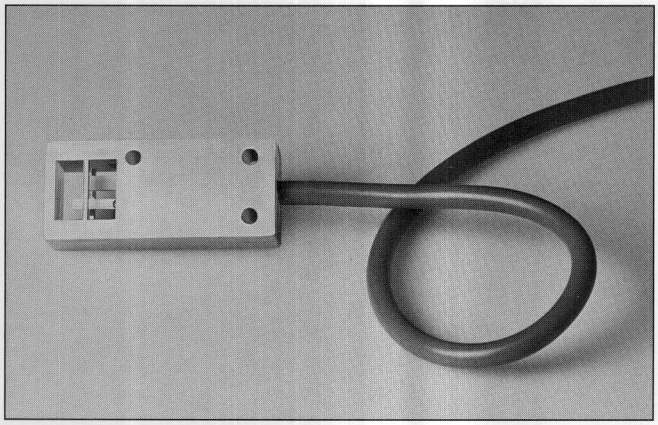


Limit Values and Permissible Deviations for Measuring Resistors are to DIN 43760, IEC 751:

t °C	Principle Values Pt 100 Pt-resistance Ohm	Ohm/K	Permissible Deviations Pt 100 DIN Class A Ohm	°C	DIN Class B Ohm	°C	Class C Ohm	°C	Class D Ohm	°C
− 50	80.31	0.40	±0.10	±0.25	±0.22	±0.6	±0.38	±1.0	±0.9	± 2.3
0	100.00	0.39	±0.06	±0.15	±0.12	±0.3	±0.24	±0.6	±0.6	±1.5
100	138.50	0.38	±0.13	±0.35	±0.30	±0.8	±0.49	±1.3	±1.1	±3.0
200	175.84	0.37	±0.20	±0.55	±0.48	±1.3	±0.74	±2.0	±1.6	±4.5
300	212.02	0.35	±0.27	±0.75	±0.64	±1.8	±0.96	±2.7	±2.1	±6.0
400	247.04	0.34	±0.33	±0.95	±0.79	±2.3	±1.17	±3.4	±2.6	±7.5
500	280.90	0.33	±0.38	±1.15	±0.93	±2.8	±1.36	±4.1	±3.0	±9.0
600	313.59	0.33	±0.43	±1.35	±1.06	±3.3	±1.54	±4.8	±3.4	±10.5

PLATINUM SENSORS FOR AIR FLOW SENSING

TRMF SERIES



This module is composed of platinum temperature sensing elements and signal processing circuit. The resistance change of the platinum temperature sensor caused by cooling effect of air flow is the principle by which air flow is detected.

By using reliable platinum temperature sensors for both cooling sensing and air temperature sensing, highly accurate air flow sensing and wide temperature range capability is realized.

For converting the sensor signal to a voltage output matching air flow rate, a specially designed HIC® is used.

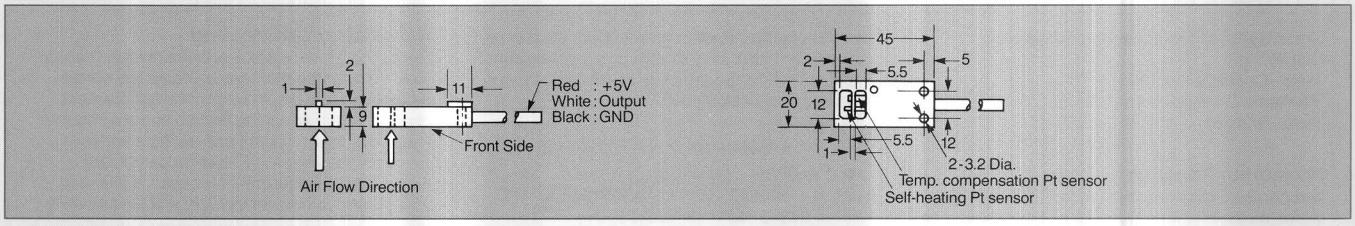
FEATURES

- **High degree of accuracy and reliability**
- **Integral temperature compensation**
- **Compact size and light weight**
- **Low voltage operation (5VDC)**

APPLICATIONS

- **Measurement of air flow through air conditioning duct systems, for the purpose of improving overall energy efficiency.**
- **Measurement of air flow to reduce combustion energy and noise in hot water heating systems.**
- **Detection of degradation of air filters in various air moving equipment.**

DIMENSIONS: mm



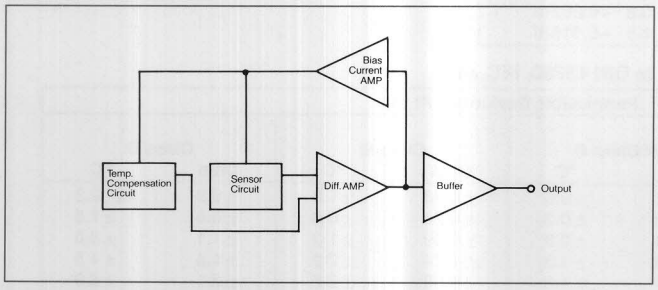
SPECIFICATIONS

Item	
Output	Analog non-linear voltage output
Supply Voltage	5.0±0.5VDC
Power Consumption	0.6W (Max. value)
Weight	13g
Operating Temperature	0 to 60°C
Operating Humidity	Max. 95%RH
Storage Condition	−20 to +70°C, Max. 95%RH

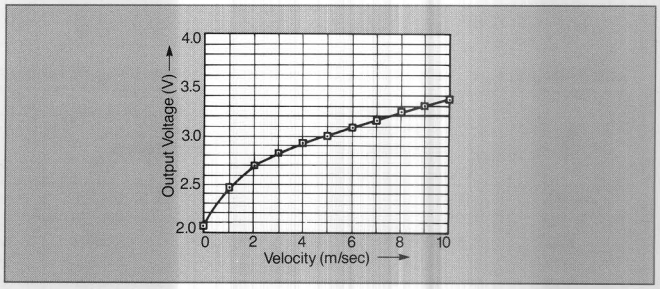
SENSING RANGE ACCURACY

Part Number			TRMF001A	TRMF001B	TRMF001C
Accuracy	15 to 35°C	at 2.0m/s	±10%	±15%	±20%
		at 6.0m/s	±5%	±7.5%	±10%
		at 10.0m/s	±5%	±7.5%	±10%
	0 to 60°C	at 2.0m/s	±20%	±30%	±50%
		at 5.0m/s	±10%	±15%	±25%
		at 10.0m/s	±20%	±30%	±50%

BLOCK DIAGRAM



OUTPUT CHARACTERISTICS



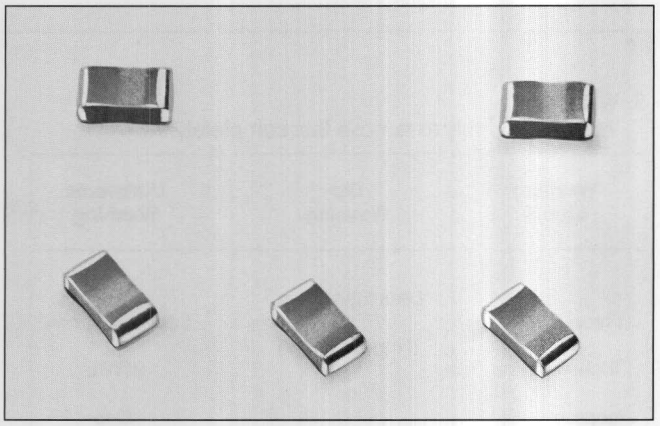
APPLICATION NOTES

1. Protect from mechanical shock.
2. Install with front side facing direction of air flow.

PTC THERMISTOR (POSISTOR®)
CHIP FOR TEMPERATURE SENSING

murata ERIE

PTH9C23 SERIES



The chip PTC Thermistors, PTH9C23 series, are SMD Posistors developed for overheat protection of power transistors, power diodes and power ICs in hybrid circuits. They may also be used as temperature sensors.

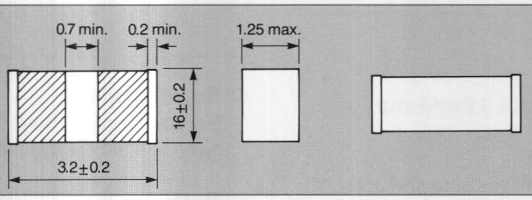
FEATURES

- **Compact and light SMT design.**
- **Excellent thermal response because of lack of coating.**
- **Solid-state construction provides excellent mechanical vibration and impact resistance.**
- **Contactless operation provides prolonged service life and noiseless operation.**

APPLICATIONS

- **Hybrid IC's**
- **Power transistors**

DIMENSIONS: mm

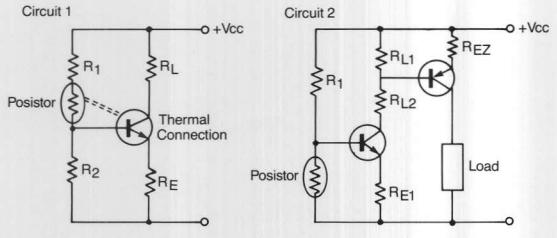


SPECIFICATIONS

Part Number	Temp. Char. (C.P.) (°C)	Resistance Value (at 25°C)	Temp. (°C) (at 4.7kΩ)	Max. Volt	Max. Current	Temp. Extent (°C)
PTH9C23AR471Q-T	AR (120)	470Ω ± 50%	135±10	16V	30mA	−20 to +150°C
PTH9C23BB471Q-T	BB (100)		115±10			−20 to +130°C
PTH9C23BD471Q-T	BD (80)		95±10			−20 to +110°C

−T : Taping (Standard quantity is 2500pcs. per reel)

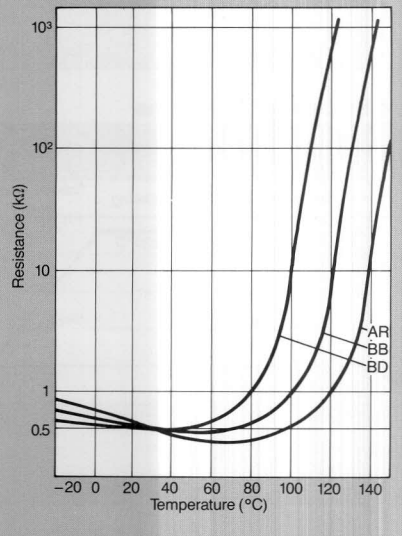
CIRCUIT EXAMPLES



Circuit 1 shows a basic circuit for protection of a transistor from overheating. When the temperature reaches a preset value, the Posistor limits the collector current to protect the transistor from overheating.

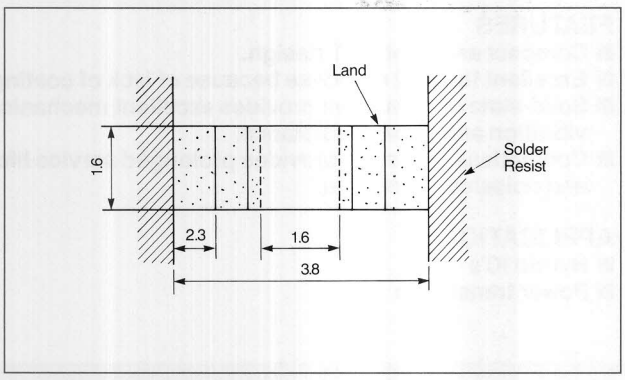
In Circuit 2, when the temperature reaches a preset value, the transistor is turned on to operate the load circuit. Examples of load circuits are: turning off a power supply through a relay, signaling temperature limits with an alarm or buzzer.

RESISTANCE-TEMPERATURE CHARACTERISTICS



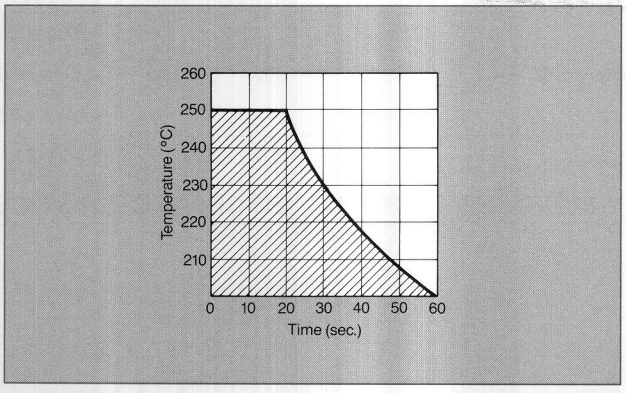
APPLICATION NOTES

1. **Standard Land Pattern Dimensions**

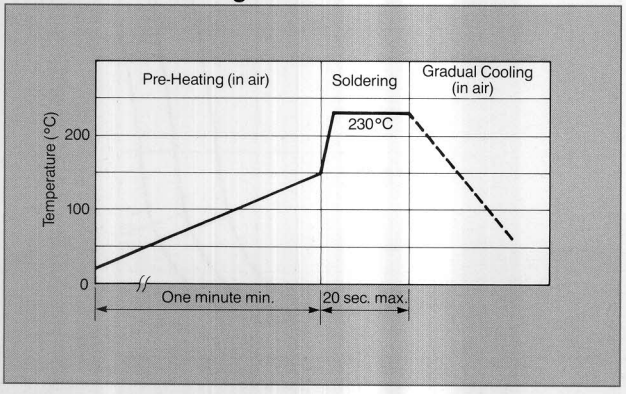


2. **Soldering Conditions**
   Use Reflow Soldering.
   Use Cream Solder – Ag 2wt% min. Cl 0.2wt% max.

- **Soldering Temperature and Time**
  Soldering must be carried out within the shaded area of the following graph.
  When soldering is repeated, the allowed time is the accumulated time.



- **Standard Soldering Conditions**



3. **Washing**
   Wash thoroughly to remove flux completely.

Washing Liquid	Dip Washing	Ultrasonic Washing
Freon Tricho-ethane Isopropyl Alcohol	Less than 5 min. (Normal Temp.) or Less than 2 min. (40°C max.)	Less than 1 min. 20W/L 10 to approx. 100kHz

4. **Resin Coating**
   Select a resin where hardening and shrinkage are low.
   Note that some resin materials may shorten the PTH's life.

5. **Remarks**
   Confirm the reliability and safety of complete system.
   Provide a failsafe system.

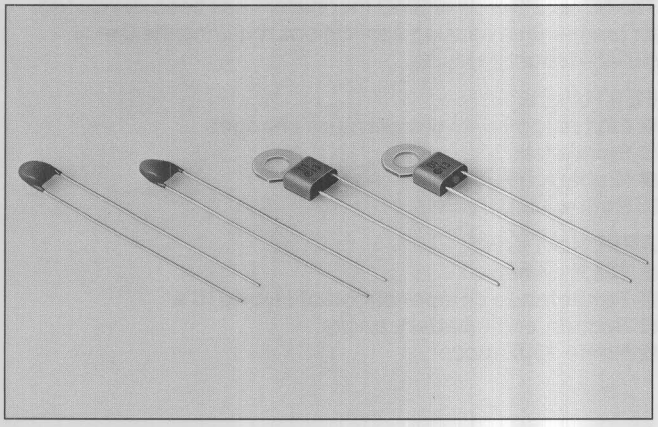
STORAGE

To prevent damage from soldering, be sure to observe the following storage precautions.

1. Store in ambient temperature of 40°C maximum, and ambient RH of 70% maximum. Use within 3 months.
2. Seal again promptly or store in a desiccator containing a drying agent after breaking the seal of the smallest package.
3. Store where there are no harmful gases containing sulfur or chlorine.

PTH THERMISTORS TEMPERATURE SENSING FOR POWER TRANSISTOR PROTECTION

PTH9M/59F SERIES



This series is best suited for protection of power transistors. This is best accomplished with the PTH9M04 style. Additionally, air temperature can be sensed best with the PTH59 style. Either style can be chosen to react at temperatures from 60°C to 120°C.

FEATURES

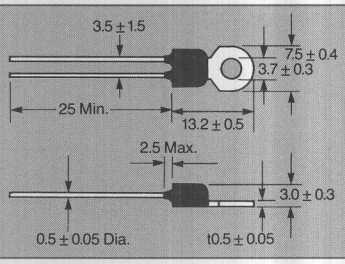
- **Mounts easily**
- **Wide selection of switch temperatures available**
- **Solid-state device**
- **Long life due to no contacts**
- **Low cost**
- **Automatically re-setting**

APPLICATIONS

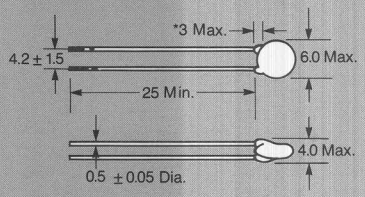
- **Power transistors**
- **Power diodes**
- **Hybrid IC's**
- **Power supplies**

DIMENSIONS: mm

PTH9M



PTH59F



*Coating Extension on Lead

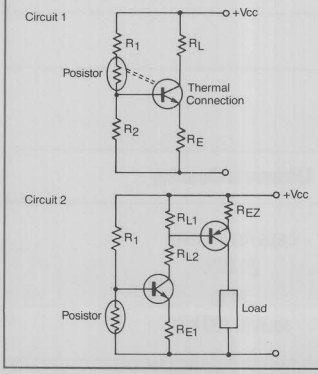
SPECIFICATIONS

Part Number		Temp. Char.		Sensing Temp.	Resistance Value (Ω)					
PTH9M	PTH59F	(C.P.)	(°C)	TS (°C)	25°C	TS-10 (°C)		TS (°C)		
PTH9M04BH471TS2F333	PTH59F04BH471TS	BH	(40)	60	100Ω max.	50	330Ω max.	60	470Ω min.	
PTH9M04BG471TS2F333	PTH59F04BG471TS	BG	(50)	70		60		70		
PTH9M04BF471TS2F333	PTH59F04BF471TS	BF	(60)	80		70		80		
PTH9M04BE471TS2F333	PTH59F04BE471TS	BE	(70)	90		80		90		
PTH9M04BD471TS2F333	PTH59F04BD471TS	BD	(80)	100		90		100		
PTH9M04BC471TS2F333	PTH59F04BC471TS	BC	(90)	110		100		110		
PTH9M04BB471TS2F333	PTH59F04BB471TS	BB	(100)	120		110		120		
PTH9M04BH222TS2F333	PTH59F04BH222TS	BH	(40)	60	330Ω max.	50	1.5KΩ max.	60	2.2KΩ min.	
PTH9M04BG222TS2F333	PTH59F04BG222TS	BG	(50)	70		60		70		
PTH9M04BF222TS2F333	PTH59F04BF222TS	BF	(60)	80		70		80		
PTH9M04BE222TS2F333	PTH59F04BE222TS	BE	(70)	90		80		90		
PTH9M04BD222TS2F333	PTH59F04BD222TS	BD	(80)	100		90		100		
PTH9M04BC222TS2F333	PTH59F04BC222TS	BC	(90)	110		100		110		
PTH9M04BB222TS2F333	PTH59F04BB222TS	BB	(100)	120		110		120		

NOTES: V max. = 16VDC I max. = 0.1A

External dielectric withstand voltage between terminal and lead wire is 500 VDC (5 ± 1 sec.)

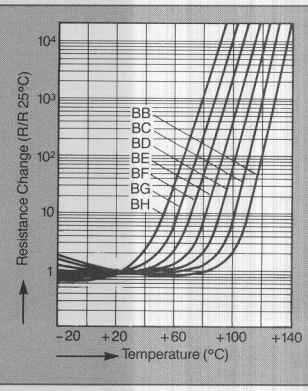
CIRCUIT EXAMPLES



Circuit 1 shows a basic circuit for protecting transistor from overheating. When temperature reaches the preset value, Posistor limits the collector current securely to protect transistor from overheating.

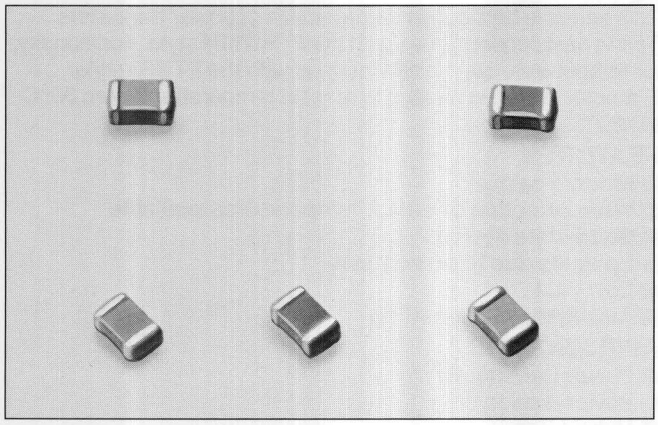
In Circuit 2, when temperature reaches the preset value, transistor is put to an energized state for operating the load circuit. Examples of load circuits are: turning off power supply through a relay, alarming the limit of temperature setting by a lamp or buzzer, and the like.

RESISTANCE-TEMPERATURE CHARACTERISTICS



NTC THERMISTOR
CHIP FOR TEMPERATURE SENSING

NTH5G SERIES



The NTH5G Series of SMD thermistors has been developed for temperature sensing applications requiring the use of surface mount products.

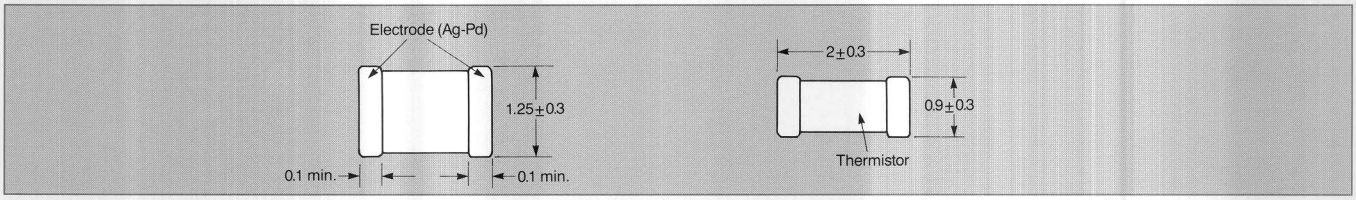
FEATURES

- **Fast response to temperature changes**
- **Small size**
- **Highly reliable**
- **Reflow solderable**

APPLICATIONS

- **TSLR camera**
- **Temperature compensation of Hybrid IC's**
- **Rechargeable battery packs**
- **Home appliances**

DIMENSIONS: mm



SPECIFICATIONS

Part Number	Resistance (k ohm) 25°C	B-constant (K) 25/50°C	Max. Current (mA) 25°C (in air)	Max. Operating Current (mA) 25°C (in air)
NTH5G39B332K01TE	3.3±10%	3950±3%	41	0.77
NTH5G35A472K01TE	4.7±10%	3500±3%	28	0.65
NTH5G36B682K01TE	6.8±10%	3650±3%	25	0.54
NTH5G36B103K01TE	10.0±10%	3650±3%	20	0.44
NTH5G39B153K01TE	15.0±10%	3950±3%	19	0.36
NTH5G39B223K01TE	22.0±10%	3950±3%	15	0.30
NTH5G40B333K01TE	33.0±10%	4050±3%	13	0.24
NTH5G40B473K01TE	47.0±10%	4050±3%	11	0.20
NTH5G41B683K01TE	68.0±10%	4150±3%	9.8	0.17

Thermal Dissipation Constant : 2.0 mW/°C Power : 200 mW Operating Temperature Range : −40 to +125°C

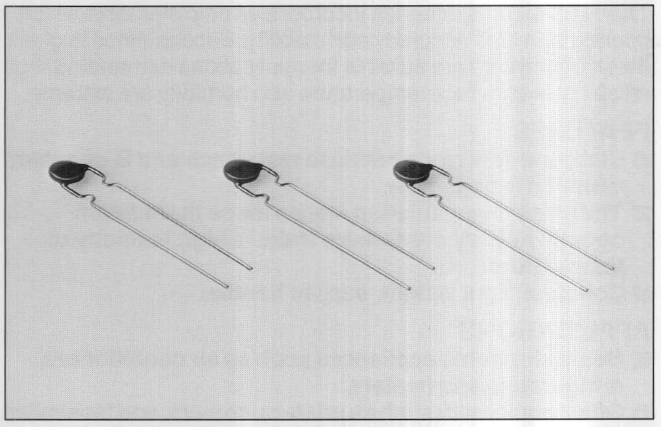
CLEANING

Cleaning Liquid	Dipping Cleaning	Ultrasonic Cleaning
Freon	Less than 5 min. (40°C max.)	Less than 1 min. 20 W/L 10 to several 100 kHz
Trichloro-ethane		
Isopropyl Alcohol		

NTC THERMISTOR
DISC FOR TEMPERATURE SENSING AND COMPENSATING

muRata ERIE

NTH5D SERIES



The NTH5D Series of NTC thermistors provides a wide range of resistances and B-constants.

This makes them perfect for use in various applications as devices for temperature sensors and temperature compensation.

FEATURES

- **Thermally stable with consistent performance.**
- **Very low deviation in temperature index.**
- **Highly reliable.**
- **Specifications and standards can be applied to meet any application and purpose.**

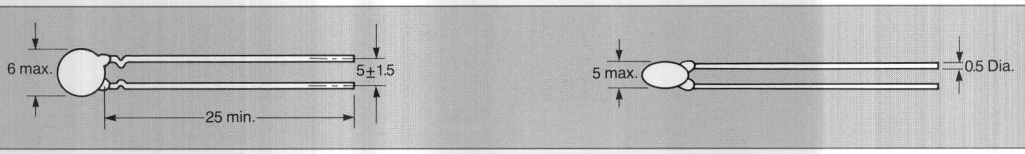
APPLICATIONS

- **Temperature compensation of transistor IC circuits.**
- **Temperature compensation of measuring equipment and various circuits.**
- **Temperature sensor and temperature control for home appliances.**

PART NUMBERING SYSTEM

NTH	5D	221	K	A
THERMISTOR	DIAMETER	RESISTANCE	TOLERANCE K=±10%	MODIFICATION A=Formed Lead

DIMENSIONS: mm

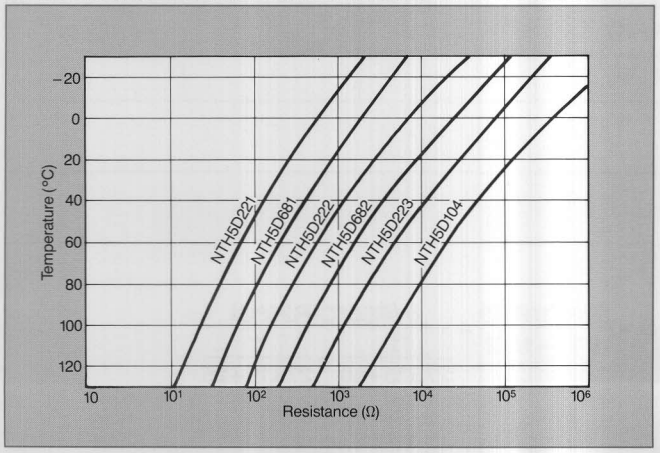


SPECIFICATIONS

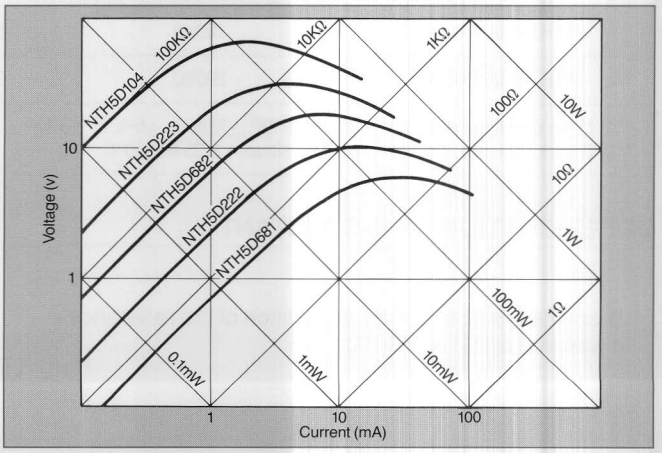
Part Number	Resistance 25°C (Ω)	B Constant 25/50°C (°K)	Resistance Temp. Coeff. 25°C (%/°C)	Part Number	Resistance 25°C (Ω)	B Constant 25/50°C (°K)	Resistance Temp. Coeff. 25°C (%/°C)
NTH5D221KA	220	3,300	−3.7	NTH5D682KA	6,800	4,100	−4.6
NTH5D331KA	330	3,300	−3.7	NTH5D103KA	10,000	4,100	−4.6
NTH5D471KA	470	3,500	−3.9	NTH5D153KA	15,000	4,100	−4.6
NTH5D681KA	680	3,500	−3.9	NTH5D223KA	22,000	4,200	−4.7
NTH5D102KA	1,000	3,800	−4.3	NTH5D333KA	33,000	4,200	−4.7
NTH5D152KA	1,500	3,800	−4.3	NTH5D473KA	47,000	4,200	−4.7
NTH5D222KA	2,200	3,900	−4.4	NTH5D683KA	68,000	4,400	−4.9
NTH5D332KA	3,300	3,900	−4.4	NTH5D104KA	100,000	4,400	−4.9
NTH5D472KA	4,700	3,900	−4.4	NTH5D154KA	150,000	4,400	−4.9

B-constant deviation: ±10% Max. allowable power: 0.56W(25°C) Typical dissipation constant: 5.6mW/°C(25°C)
Thermal time constant: 20sec. Operating temp. range: −30 to +125°C

RESISTANCE-TEMPERATURE CHARACTERISTICS

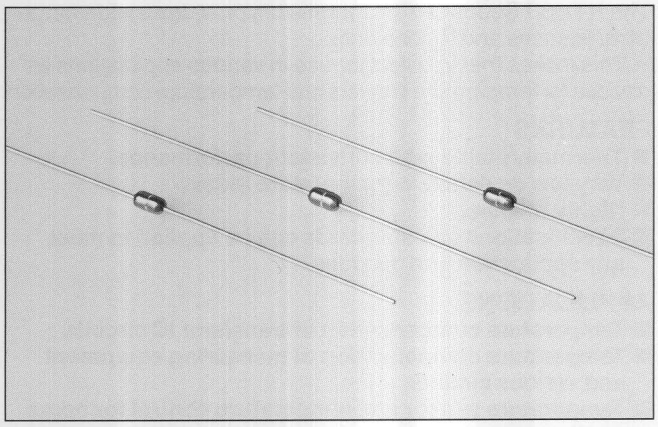


VOLTAGE-CURRENT CHARACTERISTICS



NTC THERMISTOR HIGH RELIABILITY FOR TEMPERATURE SENSING

NTH3OO SERIES



This NTC thermistor series incorporates chip elements which operate with high accuracy and stability. Encapsulated in glass, these thermistors are suitable for applications demanding high reliability even where temperature and humidity are extreme.

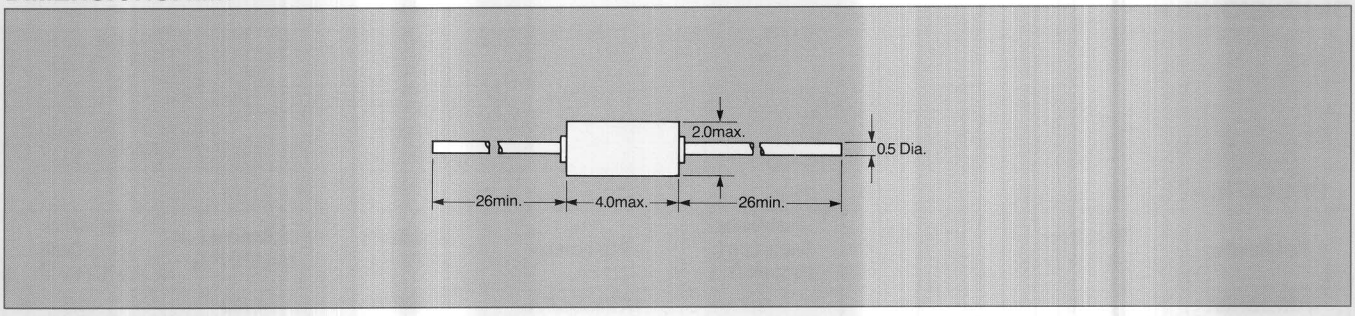
FEATURES

- **Stable performance because resistance and B-constant variation is negligible.**
- **The glass encapsulation makes these thermistors operate reliably even where there is high humidity or temperature.**
- **Compact, light weight, easy to handle.**

APPLICATIONS

- **Home electronic appliances such as air conditioners, refrigerators and heaters.**
- **Office equipment such as printers, copiers, and facsimiles.**
- **Air conditioners, engine controllers, and other electronic equipment for automobiles.**
- **General-purpose temperature sensor and for temperature compensation of electronic instruments.**

DIMENSIONS: mm



SPECIFICATIONS

Part Number	Resistance (25°C)	B-Constant**	Thermal Dissipation Constant	Thermal Time Constant	Operating Temperature Range
NTH300XH502✱01	5KΩ	3350K±3%	2.0mW/°C (Typical)	20 Seconds (Typical)	−40 to +300°C
NTH300XK103□01	10KΩ	3400K±3%			
NTH300XQ103□01	10KΩ	3650K±3%			
NTH300XW203□01	20KΩ	3950K±3%			
NTH300WA503□01	50KΩ	4000K±3%			
NTH300WC104□01	100KΩ	4100K±3%			
NTH300WE204□01	200KΩ	4200K±3%			

*1 : Letter denoting the resistance tolerance: (K : ±10%, J : ±5%, E : ±3%)
**2 : Denotes the value obtained from the resistance at 25 and 50°C.

DETERMINATION OF B-CONSTANT

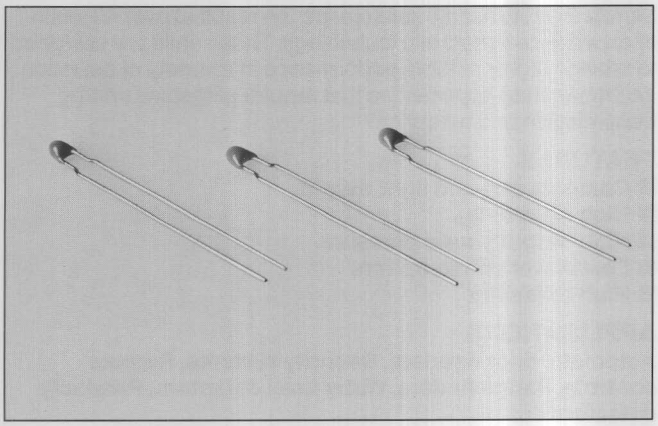
B-constant is obtained by calculation of the resistance measured at 25° and 50°C.

$$B = \frac{\ell n(RT1/RT2)}{1/T1 - 1/T2} = \frac{\ell n(R50°C/R25°C)}{\frac{1}{273.15+50} - \frac{1}{273.15+25}}$$

NTC THERMISTOR MINIATURE FOR TEMPERATURE SENSING

muRata ERIE

NTH4G SERIES



The NTH4G Series is the world's smallest thermistor that is automatically processed into a radial-leaded form with our advanced production method.

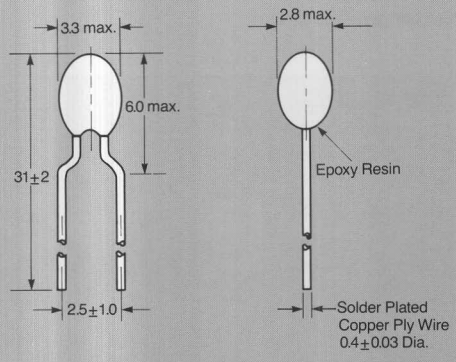
FEATURES

- **Small deviations in resistance value and B-constant.**
- **Fast responses to temperature changes.**
- **One percent tolerance available.**

APPLICATIONS

- **Air conditioners, electronic fuel injectors, etc., in automotive applications.**
- **Home electric devices like air conditioners, refrigerators, electric blankets, etc.**
- **Electronic office equipment like personal computers, printers, word processors, and others.**
- **HVAC thermostats.**

DIMENSIONS: mm



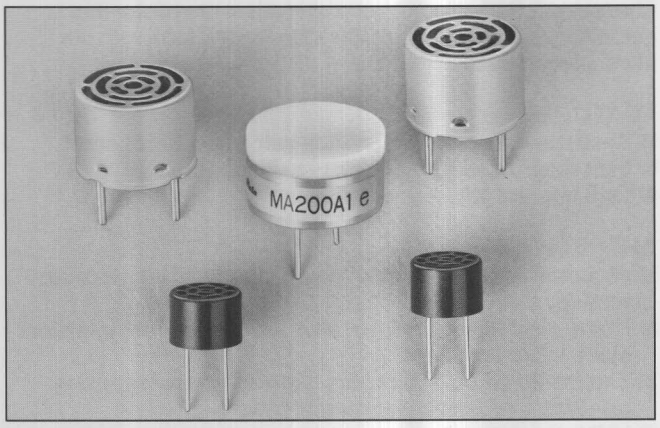
SPECIFICATIONS

Part Number	Resistance 25°C(kΩ)	B-Constant** 25/50°C(k)	Thermal Dissipation Constant	Thermal Time Constant	Operating Temperature Range
NTH4G35A202☒02	2.0	3500	2.1 (mW/°C)	1 Sec. Max. (In Liquid)	−40°C to +125°C
NTH4G37A502□02	5.0	3700			
NTH4G39A103□02	10.0	3900			
NTH4G40B203□01	20.0	4050			
NTH4G41B503□01	50.0	4150			
NTH4G42B104□01	100.0	4250			

*1 : Letter denoting the resistance tolerance (F : ±1%, E : ±3%)
**2 : B-Constant Tolerance (±1%) Max. Power 210mW

ULTRASONIC SENSORS

MA SERIES



Murata Erie ultrasonic sensors are the result of over 45 years of experience in ceramic technology. These units are designed to provide highly reliable performance in a variety of detection and measuring applications that require ultrasonic energy transmission and reception.

FEATURES

- **Compact size and light weight.**
- **High sensitivity.**
- **High output sound pressure.**
- **Low power consumption.**
- **High reliability.**

APPLICATIONS

Automatic door openers, Security systems, Remote controls, Range finders, Water level detectors, Proximity detectors.

PART NUMBERING

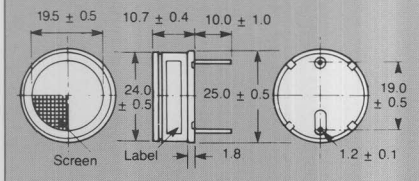
MA	40	A5	R
Ultrasonic Sensor	Nominal Frequency	Design Number	R = Receiver S = Transmitter

RECEIVER AND TRANSMITTER (DUAL USE TYPE)

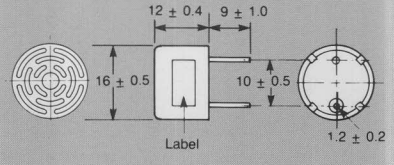
These units are designed for either continuous ultrasonic acoustic transmission *or* reception where the transmitter and receiver are positioned at different locations.

DIMENSIONS: mm

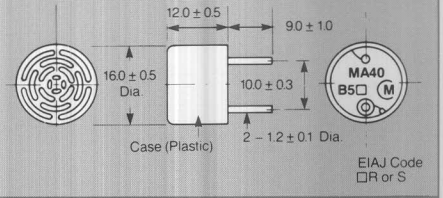
MA23L3-9



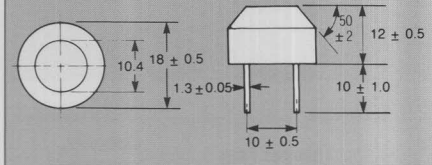
MA40A5R/S



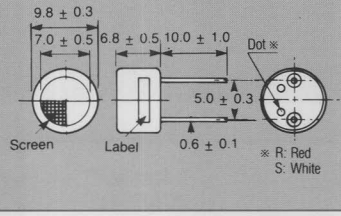
MA40B5R/S



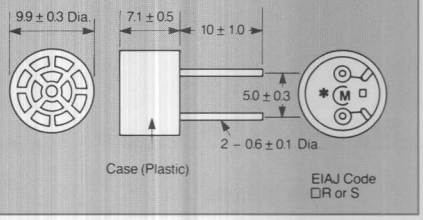
MA40E7R/S



MA40S2R/S



MA40S3R/S



SPECIFICATIONS

Part Number		MA23L3-9	MA40A5R/S	MA40B5R/S	MA40E7R/S	MA40S2R/S	MA40S3R/S
Nominal Frequency	(KHz)	23			40		
Sensitivity	(dB)	–70min	–67min	–67min	–74min	–74min	–67±6
Sound Pressure	(dB)	(102)	112 min	112 min	106 min	100 min	111±6
Directivity	(deg)	80°	50°	50°	100°	100°	100°
Capacitance	(pF)	2800	2000	2000	2200	1600	1600
Allowable Input Voltage	(Vrms)	20	20	20	20	10	10
Operating Temperature Range	(°C)	–20 to +60	–20 to +85	–20 to +85	–30 to +85	–30 to +85	–30 to +85
Detectable Range	(m)	0.2 to 6	0.2 to 6	0.2 to 6	0.2 to 3	0.2 to 4	0.2 to 4
Resolution	(mm)	15			9		
Weight	(g)	5.7	2.8	2.3	4.5	0.7	0.6
Features		Broad-Band	Broad-Band	Black Case	Waterproof	Miniature	Black Case

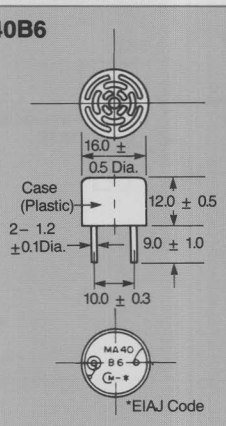
Sensitivity : 0dB=1V/μbar Sound Pressure at 30cm : 0dB=2×10^{-4}μbar

RECEIVER AND TRANSMITTER (COMBINED USE TYPE)

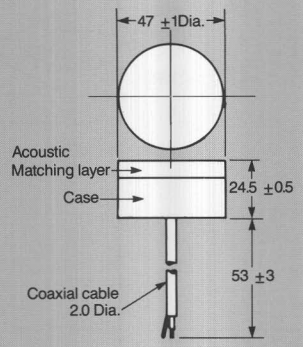
These units are designed for pulsed alternate transmit/receive cycle applications with a single unit functioning as both the transmitter and receiver. Individual parts can be used where one is the transmitter and the one the receiver, however sensitivity will be less than that of a dual use type.

DIMENSIONS: mm

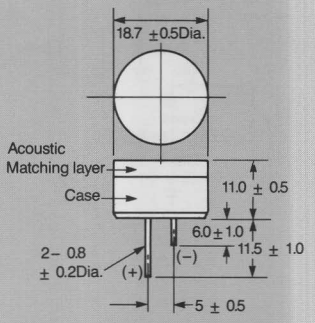
MA40B6



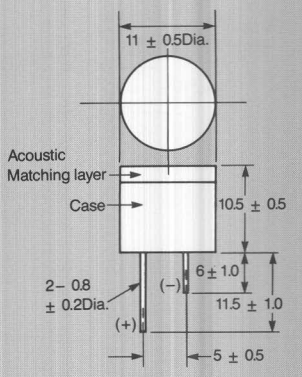
MA80A1



MA200A1



MA400A1



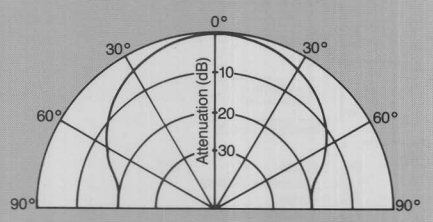
SPECIFICATIONS

Part Number		MA40B6	MA80A1	MA200A1	MA400A1
Nominal Frequency	(KHz)	40	75	200	400
Sensitivity	(dB)	–54min (at 30cm)	–47min (at 50cm)	–54min (at 20cm)	–74min (at 10cm)
Directivity	(deg)	40°	7°	7°	7°
Capacitance	(pF)	1100	940	360	180
Allowable Input Voltage	(Vrms)	20	30	20	20
Operating Temperature Range	(°C)	–20 to +85	–20 to +40	–20 to +60	–20 to +60
Detectable Range	(m)	0.2 to 4	0.5 to 5	0.2 to 1	0.06 to 0.3
Resolution	(mm)	9	4	2	1
Weight	(g)	1.8	93	6.0	2.0
Features		General Use	High Resolution		

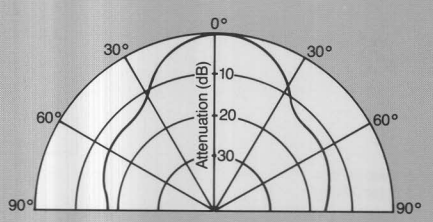
Sensitivity : 0dB=20Vpp

DIRECTIVITY CHARACTERISTICS

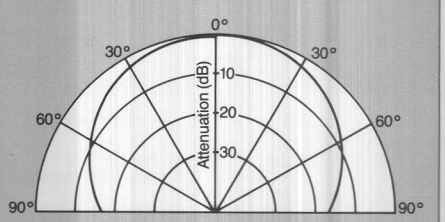
MA23L3



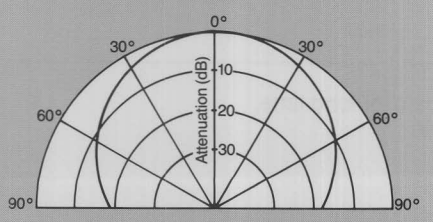
MA40A3/A5/B5



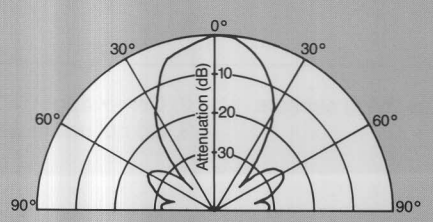
MA40S2



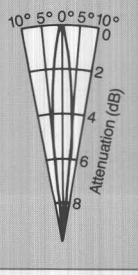
MA40E1



MA40B6

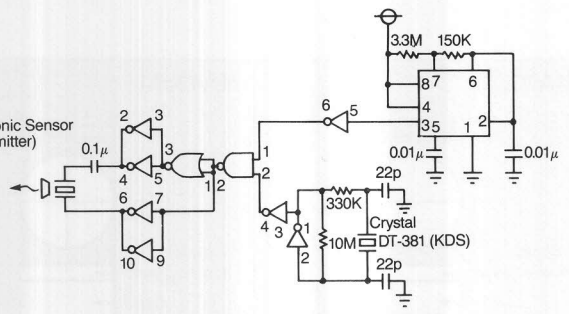


MA80A1/200A1/400A1

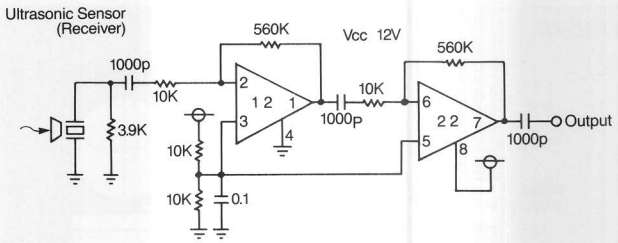


TYPICAL APPLICATION CIRCUITS

Pulse-Transmitting Circuit

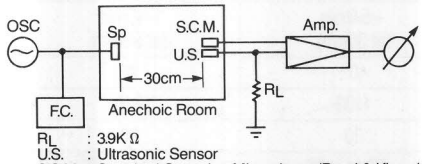


Receiving Circuit



TEST CIRCUITS

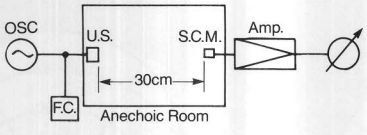
Receiver



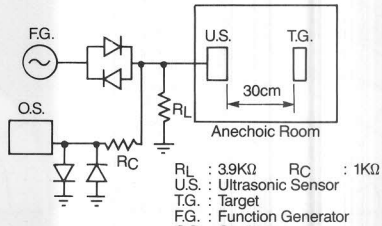
RL : 3.9K Ω
U.S. : Ultrasonic Sensor
S.C.M. : Standard Capacitor Microphone (Bruel & Kjaer (4135))
Amp. : Amplifier (Bruel & Kjaer (2604))
OSC. : Oscillator (Bruel & Kjaer (1013))
Sp. : Tweeter
F.C. : Frequency Counter

OdB = 2×10^{-4} μbar

Transmitter



U.S. : Ultrasonic Sensor
S.C.M. : Standard Capacitor Microphone (Bruel & Kjaer (4135))
Amp. : Amplifier (Bruel & Kjaer (2604))
Input Voltage : 10V r.m.s.
F.C. : Frequency Control (dB=1V/μ bar)



RL : 3.9KΩ RC : 1KΩ
U.S. : Ultrasonic Sensor
T.G. : Target
F.G. : Function Generator
O.S. : Oscilloscope

APPLICATION NOTES

1. Pay attention to the mounting position as these sensors have directivity.
2. Do not apply DC-bias for long time.
3. Do not use in water.